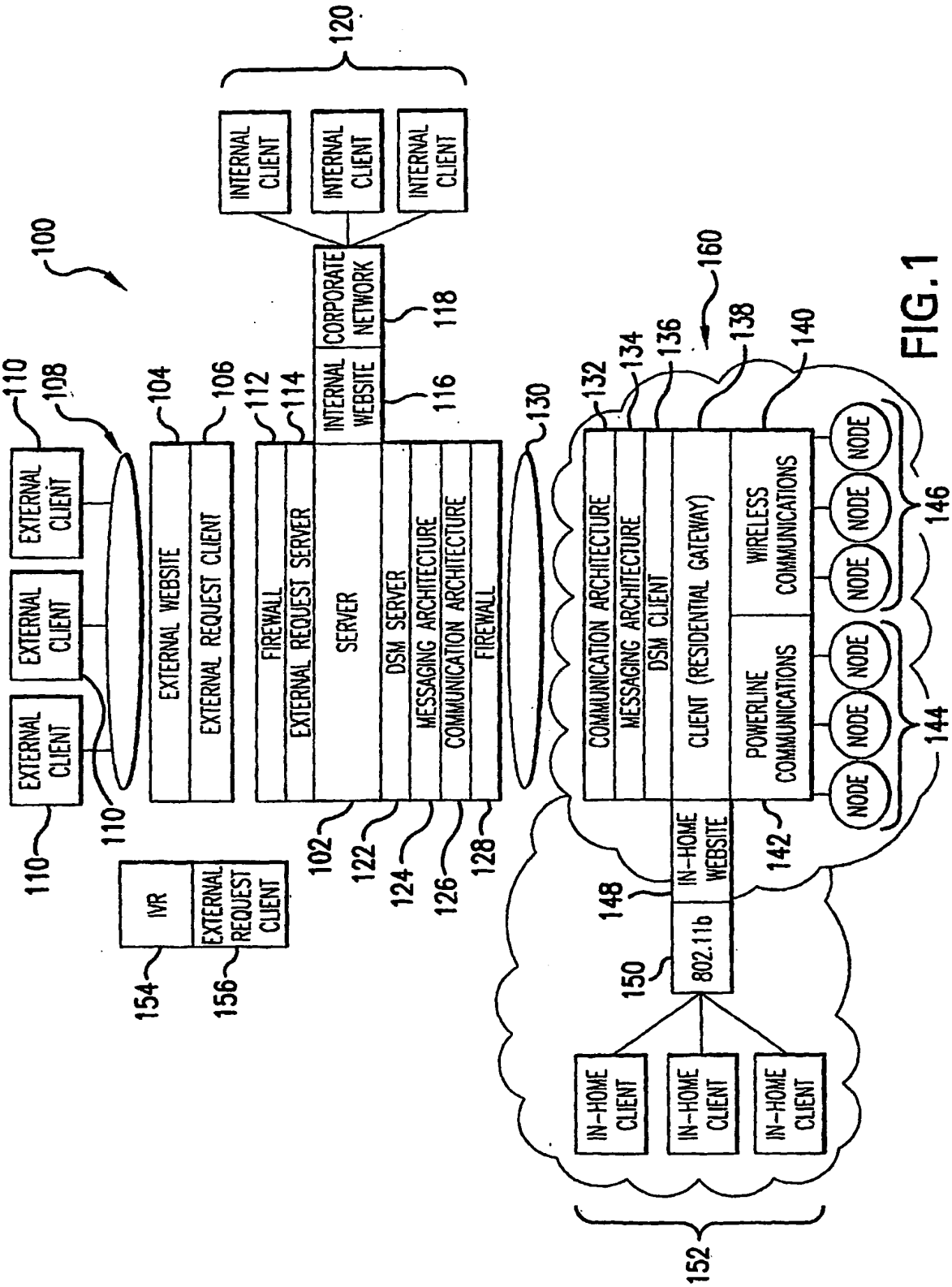
100
110
108
EXTERNAL CLIENT
EXTERNAL CLIENT
EXTERNAL CLIENT
110
110
104
106
EXTERNAL WEBSITE
EXTERNAL REQUEST CLIENT
112
114
FIREWALL
EXTERNAL REQUEST SERVER
SERVER
DSM SERVER
MESSAGING ARCHITECTURE
COMMUNICATION ARCHITECTURE
FIREWALL
INTERNAL WEBSITE
CORPORATE NETWORK
116
118
120
INTERNAL CLIENT
INTERNAL CLIENT
INTERNAL CLIENT
130
132
134
136
138
140
160
COMMUNICATION ARCHITECTURE
MESSAGING ARCHITECTURE
DSM CLIENT
CLIENT (RESIDENTIAL GATEWAY)
POWERLINE COMMUNICATIONS
WIRELESS COMMUNICATIONS
NODE
NODE
NODE
NODE
NODE
NODE
146
144
142
IN-HOME WEBSITE
148
802.11b
150
IN-HOME CLIENT
IN-HOME CLIENT
IN-HOME CLIENT
152
IVR
EXTERNAL REQUEST CLIENT
154
156
102
122
124
126
128

FIG. 1

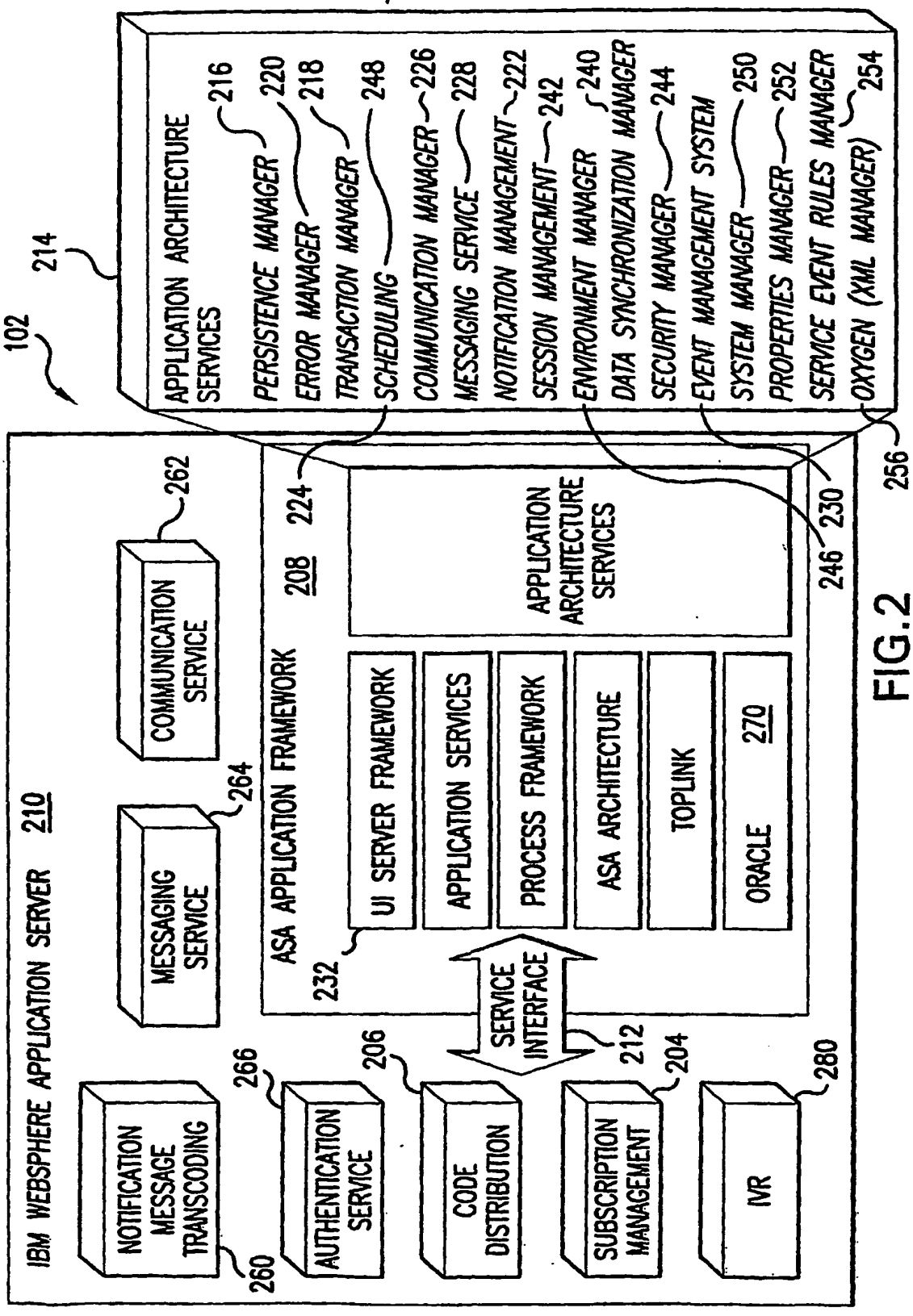
102
214
APPLICATION ARCHITECTURE SERVICES
216
PERSISTENCE MANAGER
220
ERROR MANAGER
218
TRANSACTION MANAGER
248
SCHEDULING
COMMUNICATION MANAGER
226
MESSAGING SERVICE
228
NOTIFICATION MANAGEMENT
222
SESSION MANAGEMENT
242
ENVIRONMENT MANAGER
240
DATA SYNCHRONIZATION MANAGER
SECURITY MANAGER
244
EVENT MANAGEMENT SYSTEM
SYSTEM MANAGER
250
PROPERTIES MANAGER
252
SERVICE EVENT RULES MANAGER
254
OXYGEN (XML MANAGER)
256
246
230
224
262
COMMUNICATION SERVICE
264
MESSAGING SERVICE
IBM WEBSPHERE APPLICATION SERVER 210
ASA APPLICATION FRAMEWORK 208
232
UI SERVER FRAMEWORK
APPLICATION SERVICES
PROCESS FRAMEWORK
ASA ARCHITECTURE
TOPLINK
ORACLE 270
APPLICATION ARCHITECTURE SERVICES
SERVICE INTERFACE
212
266
AUTHENTICATION SERVICE
206
CODE DISTRIBUTION
204
SUBSCRIPTION MANAGEMENT
280
IVR
260
NOTIFICATION MESSAGE TRANSCODING

FIG.2

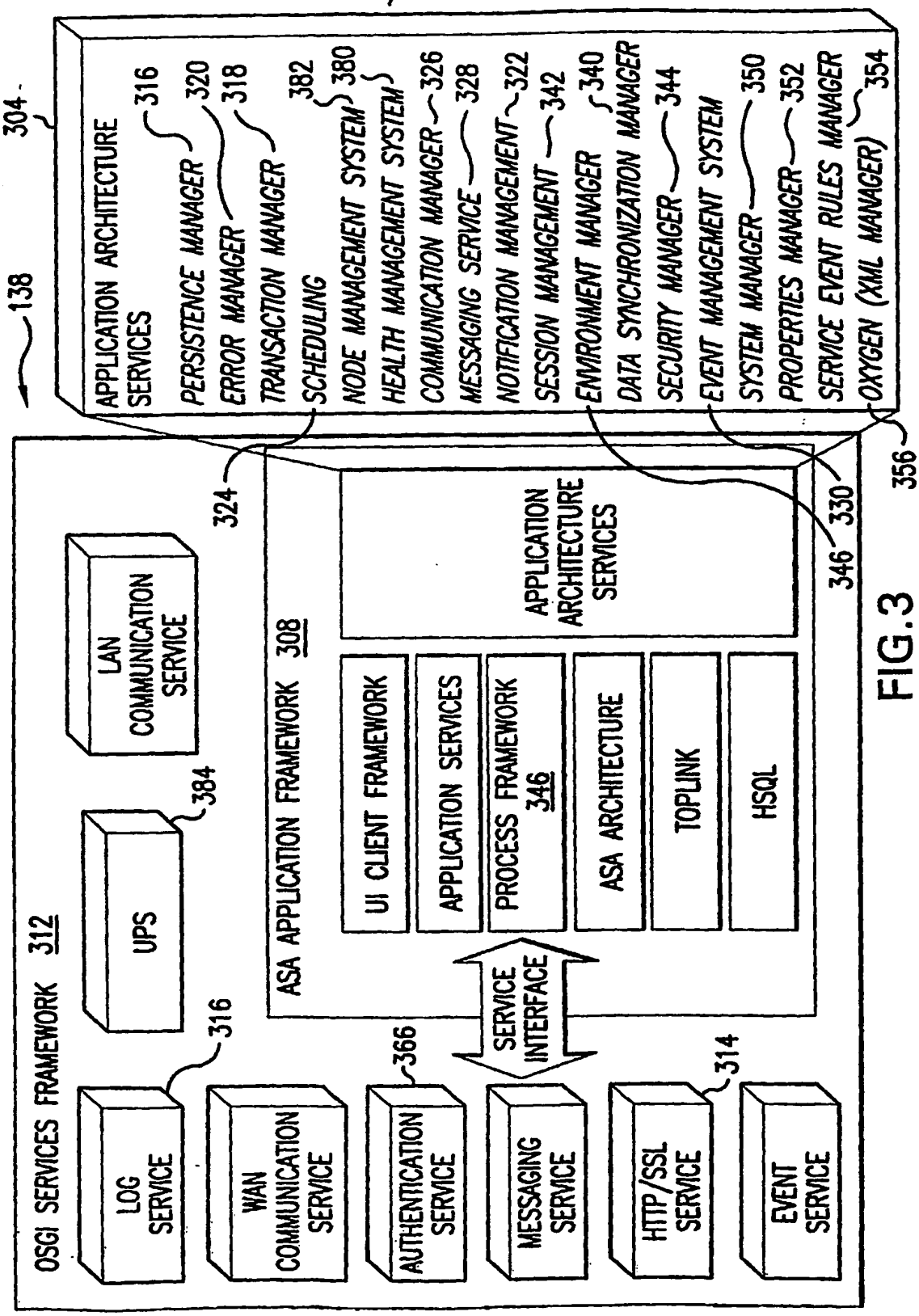
OSGI SERVICES FRAMEWORK 312
LOG SERVICE
316
WAN COMMUNICATION SERVICE
AUTHENTICATION SERVICE
366
MESSAGING SERVICE
HTTP/SSL SERVICE
314
EVENT SERVICE
UPS
384
LAN COMMUNICATION SERVICE
ASA APPLICATION FRAMEWORK 308
SERVICE INTERFACE
UI CLIENT FRAMEWORK
APPLICATION SERVICES
PROCESS FRAMEWORK 346
ASA ARCHITECTURE
TOPLINK
HSQL
324
346
330
356
APPLICATION ARCHITECTURE SERVICES
138
304
APPLICATION ARCHITECTURE SERVICES 316
PERSISTENCE MANAGER 320
ERROR MANAGER 318
TRANSACTION MANAGER 382
SCHEDULING 380
NODE MANAGEMENT SYSTEM
HEALTH MANAGEMENT SYSTEM
COMMUNICATION MANAGER 326
MESSAGING SERVICE 328
NOTIFICATION MANAGEMENT 322
SESSION MANAGEMENT 342
ENVIRONMENT MANAGER 340
DATA SYNCHRONIZATION MANAGER
SECURITY MANAGER 344
EVENT MANAGEMENT SYSTEM
SYSTEM MANAGER 350
PROPERTIES MANAGER 352
SERVICE EVENT RULES MANAGER
OXYGEN (XML MANAGER) 354

FIG.3

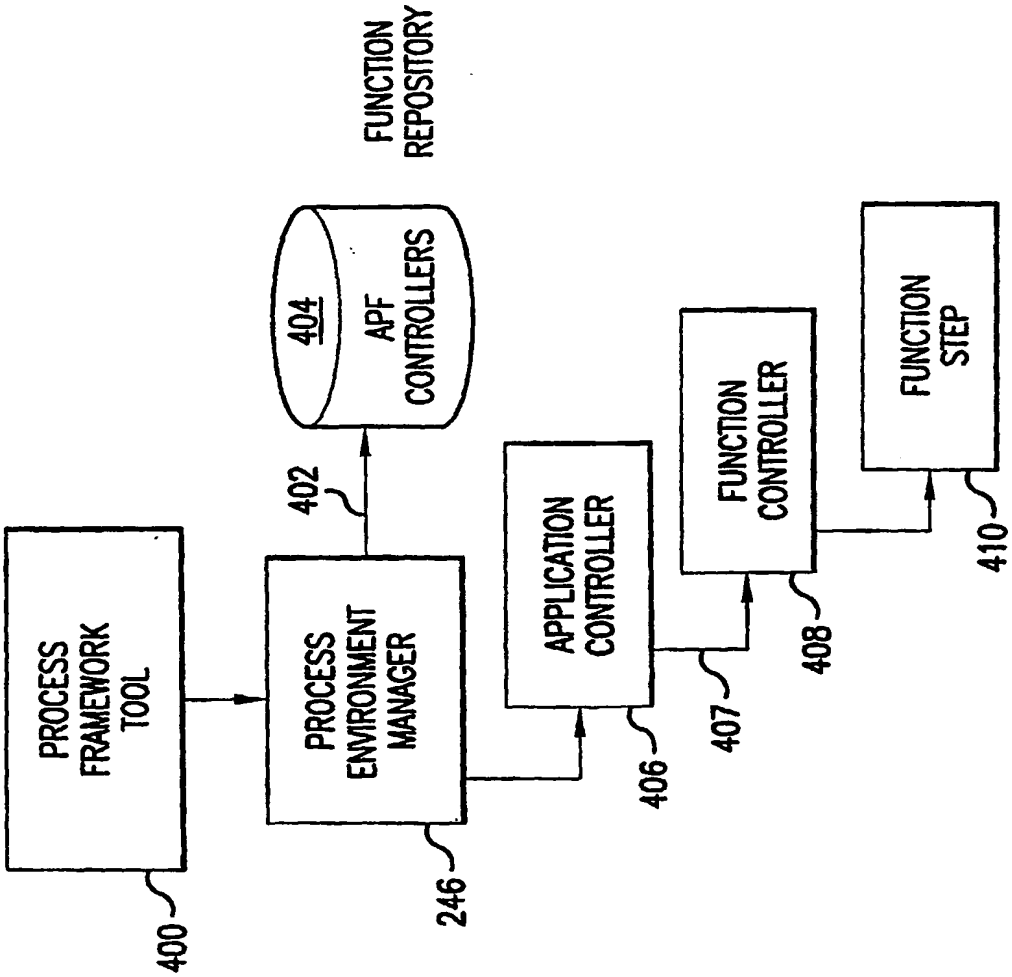
FUNCTION REPOSITORY
404
APF CONTROLLERS
402
PROCESS FRAMEWORK TOOL
PROCESS ENVIRONMENT MANAGER
APPLICATION CONTROLLER
FUNCTION CONTROLLER
FUNCTION STEP
400
246
406
407
408
410

FIG.4

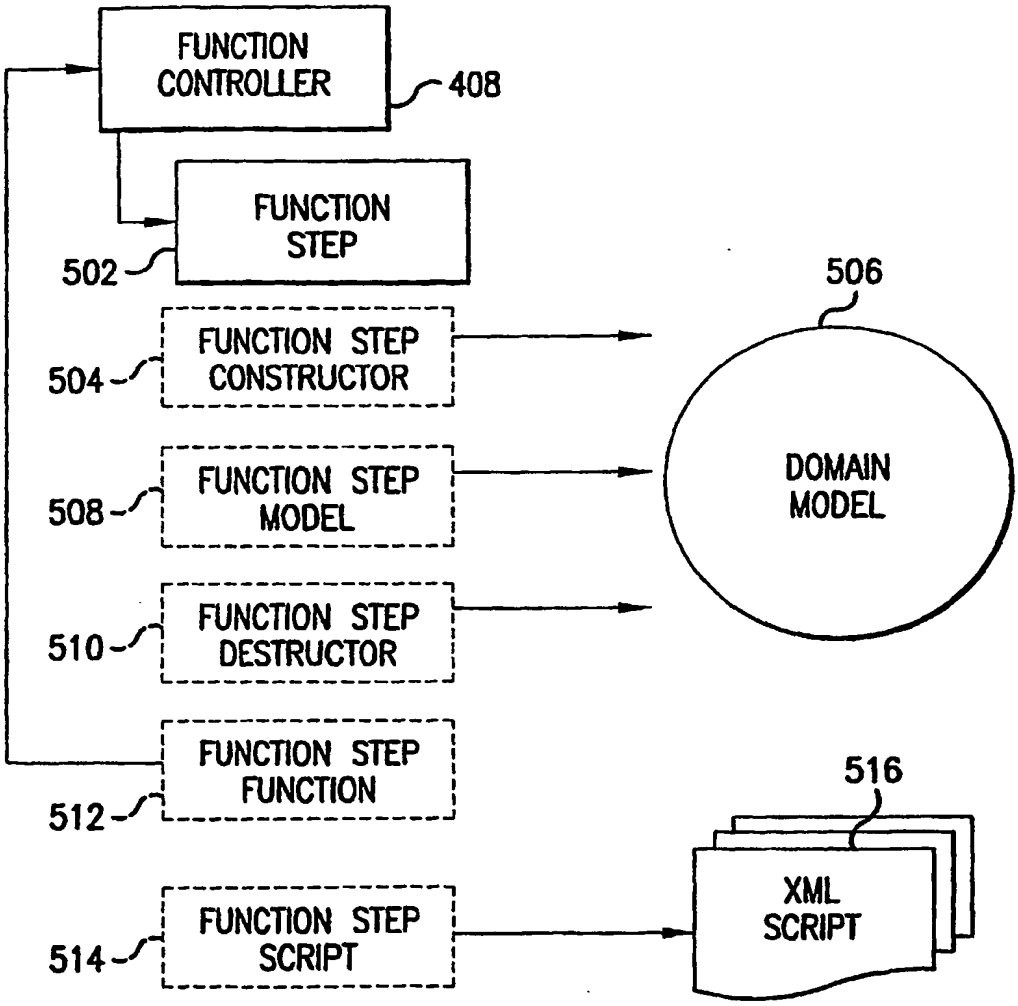
FUNCTION CONTROLLER
408
FUNCTION STEP
502
506
FUNCTION STEP CONSTRUCTOR
504
FUNCTION STEP MODEL
508
DOMAIN MODEL
FUNCTION STEP DESTRUCTOR
510
FUNCTION STEP FUNCTION
512
516
XML SCRIPT
FUNCTION STEP SCRIPT
514

FIG.5

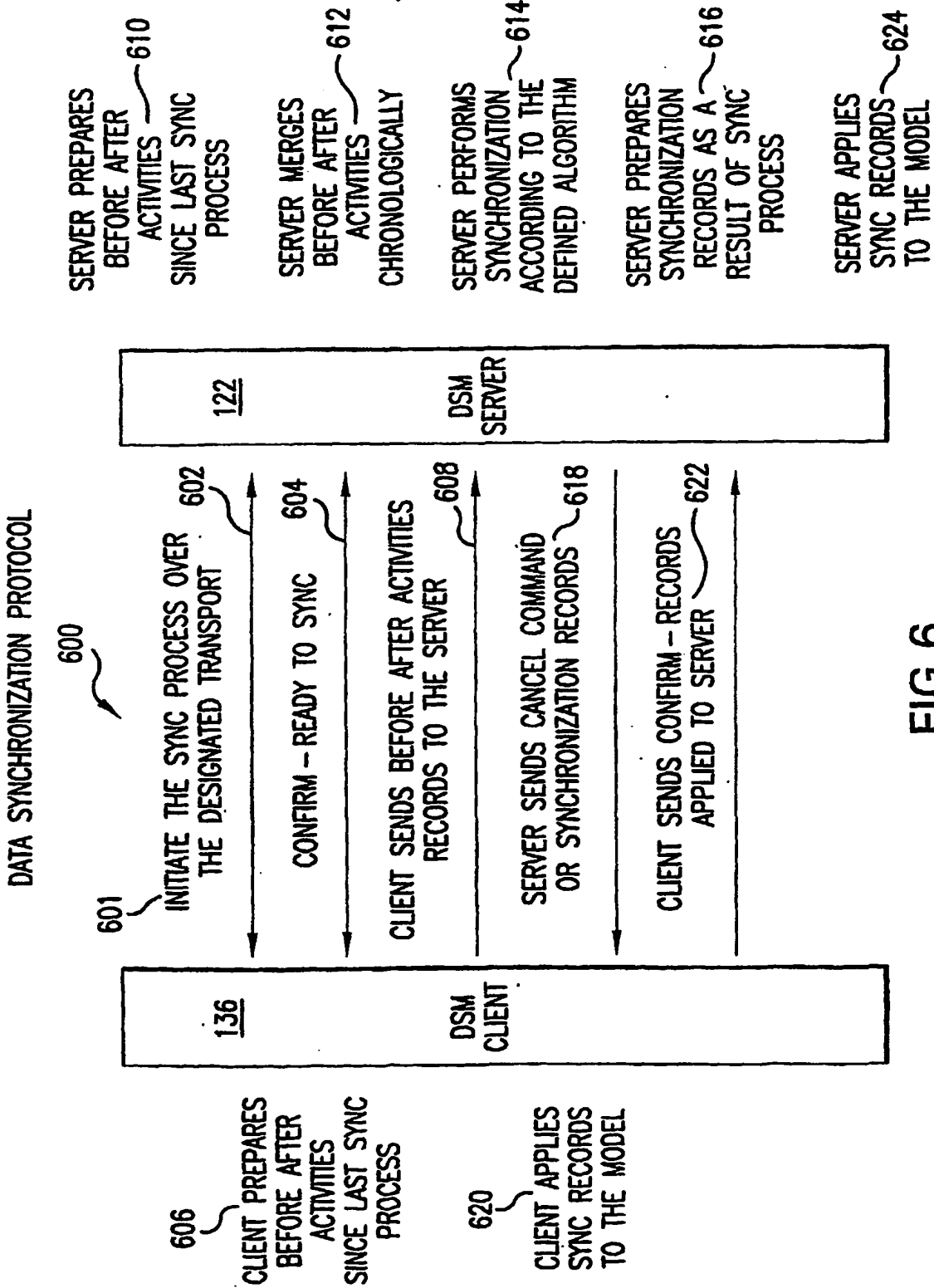
DATA SYNCHRONIZATION PROTOCOL
600
601
INITIATE THE SYNC PROCESS OVER THE DESIGNATED TRANSPORT
602
CONFIRM – READY TO SYNC
604
CLIENT SENDS BEFORE AFTER ACTIVITIES RECORDS TO THE SERVER
608
SERVER SENDS CANCEL COMMAND OR SYNCHRONIZATION RECORDS
618
CLIENT SENDS CONFIRM – RECORDS APPLIED TO SERVER
622
136
DSM CLIENT
122
DSM SERVER
606
CLIENT PREPARES BEFORE AFTER ACTIVITIES SINCE LAST SYNC PROCESS
620
CLIENT APPLIES SYNC RECORDS TO THE MODEL
SERVER PREPARES BEFORE AFTER ACTIVITIES SINCE LAST SYNC PROCESS
610
SERVER MERGES BEFORE AFTER ACTIVITIES CHRONOLOGICALLY
612
SERVER PERFORMS SYNCHRONIZATION ACCORDING TO THE DEFINED ALGORITHM
614
SERVER PREPARES SYNCHRONIZATION RECORDS AS A RESULT OF SYNC PROCESS
616
SERVER APPLIES SYNC RECORDS TO THE MODEL
624

FIG.6

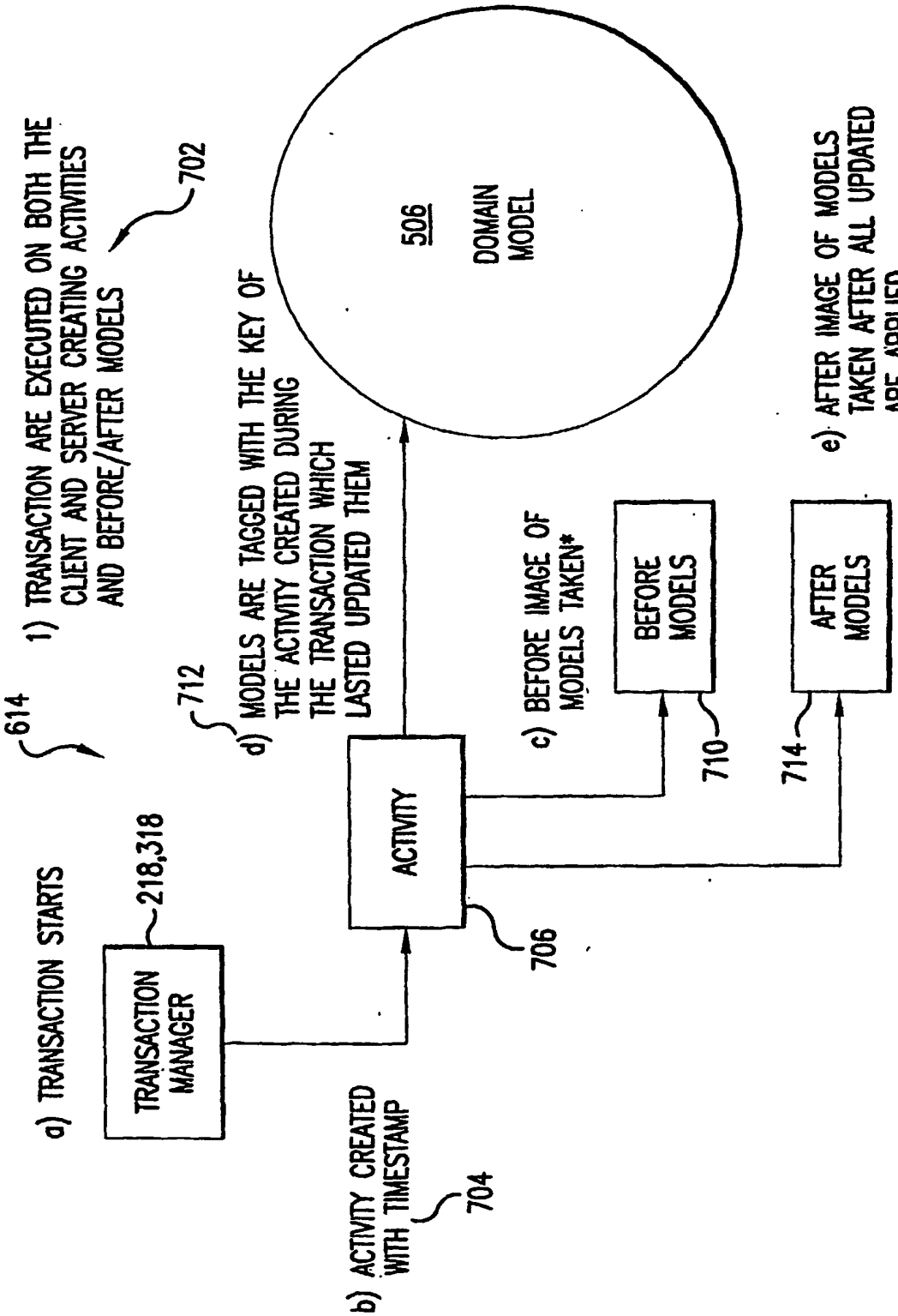
a) TRANSACTION STARTS
TRANSACTION MANAGER
218,318
b) ACTIVITY CREATED WITH TIMESTAMP
704
ACTIVITY
706
614
1) TRANSACTION ARE EXECUTED ON BOTH THE CLIENT AND SERVER CREATING ACTIVITIES AND BEFORE/AFTER MODELS
702
712
d) MODELS ARE TAGGED WITH THE KEY OF THE ACTIVITY CREATED DURING THE TRANSACTION WHICH LASTED UPDATED THEM
506
DOMAIN MODEL
c) BEFORE IMAGE OF MODELS TAKEN*
BEFORE MODELS
710
AFTER MODELS
714
e) AFTER IMAGE OF MODELS TAKEN AFTER ALL UPDATED ARE APPLIED
*EXECUTED THROUGH THE OBSERVABLE INTERFACES IN THE MODEL

FIG.7

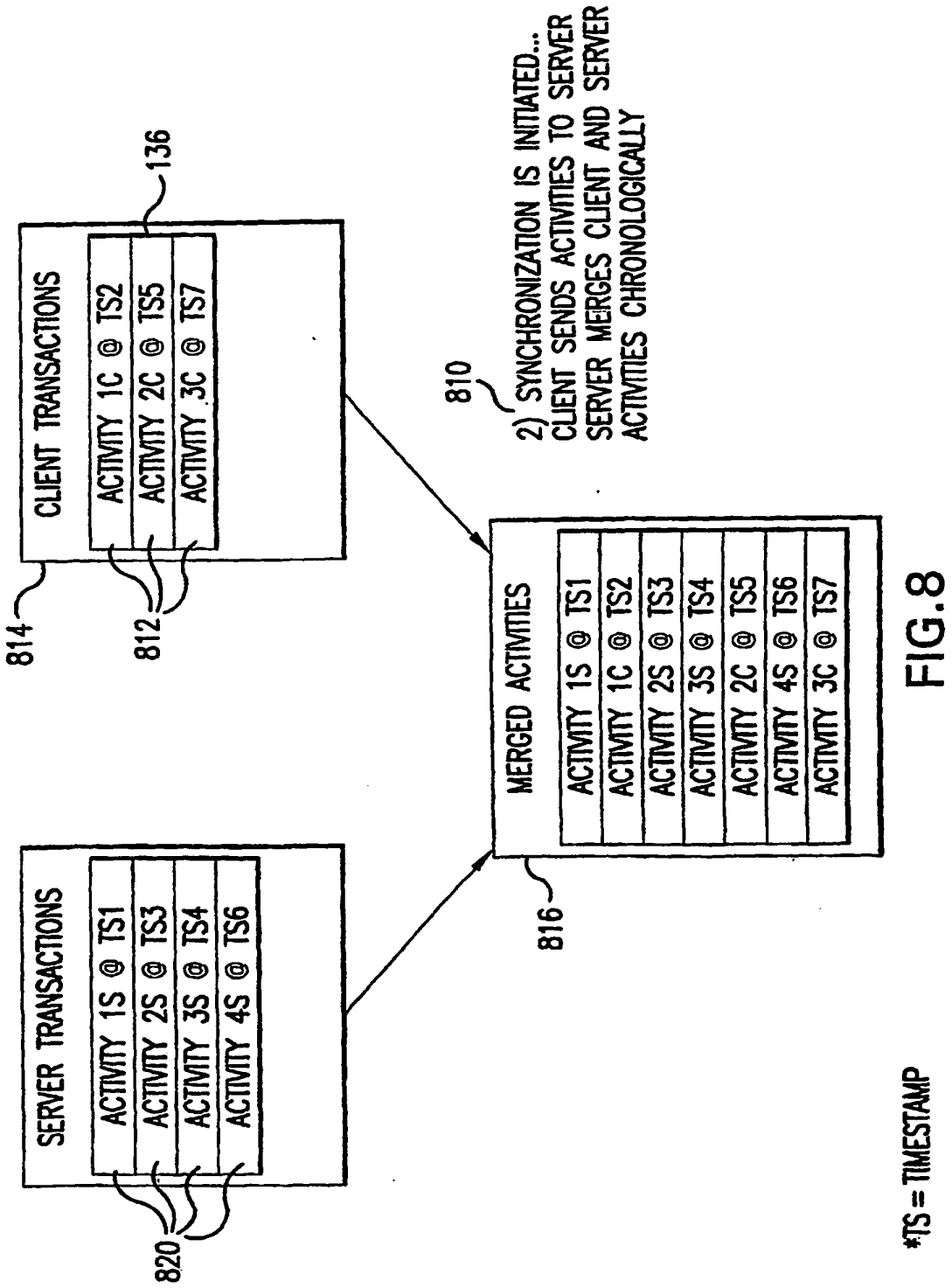
CLIENT TRANSACTIONS
ACTIVITY 1C @ TS2
ACTIVITY 2C @ TS5
ACTIVITY 3C @ TS7
136
814
812
SERVER TRANSACTIONS
ACTIVITY 1S @ TS1
ACTIVITY 2S @ TS3
ACTIVITY 3S @ TS4
ACTIVITY 4S @ TS6
820
810
2) SYNCHRONIZATION IS INITIATED... CLIENT SENDS ACTIVITIES TO SERVER SERVER MERGES CLIENT AND SERVER ACTIVITIES CHRONOLOGICALLY
MERGED ACTIVITIES
ACTIVITY 1S @ TS1
ACTIVITY 1C @ TS2
ACTIVITY 2S @ TS3
ACTIVITY 3S @ TS4
ACTIVITY 2C @ TS5
ACTIVITY 4S @ TS6
ACTIVITY 3C @ TS7
816
*TS = TIMESTAMP

FIG.8

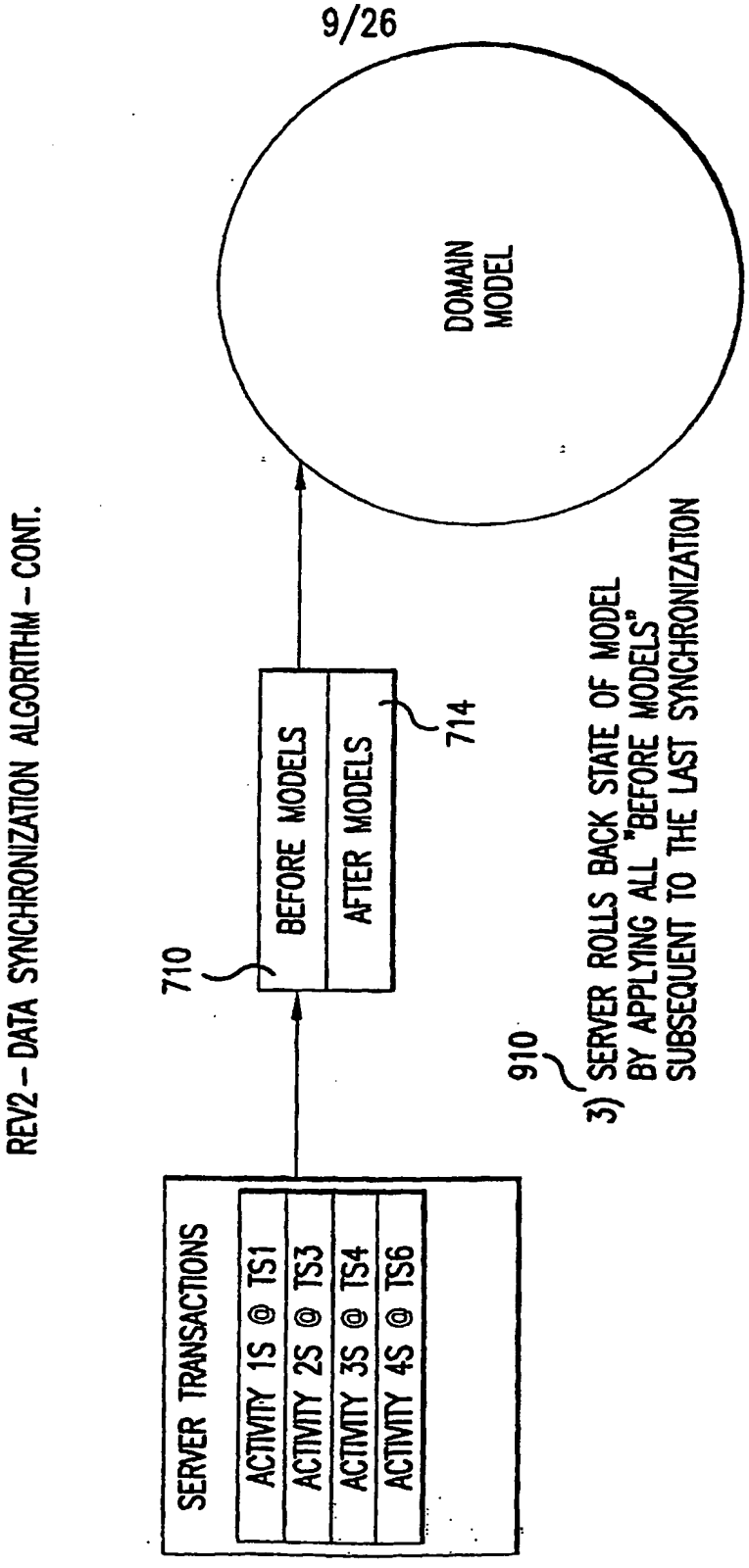
REV2 – DATA SYNCHRONIZATION ALGORITHM – CONT.
DOMAIN MODEL
BEFORE MODELS
AFTER MODELS
714
710
910
3) SERVER ROLLS BACK STATE OF MODEL BY APPLYING ALL "BEFORE MODELS" SUBSEQUENT TO THE LAST SYNCHRONIZATION
SERVER TRANSACTIONS
ACTIVITY 1S @ TS1
ACTIVITY 2S @ TS3
ACTIVITY 3S @ TS4
ACTIVITY 4S @ TS6

FIG.9

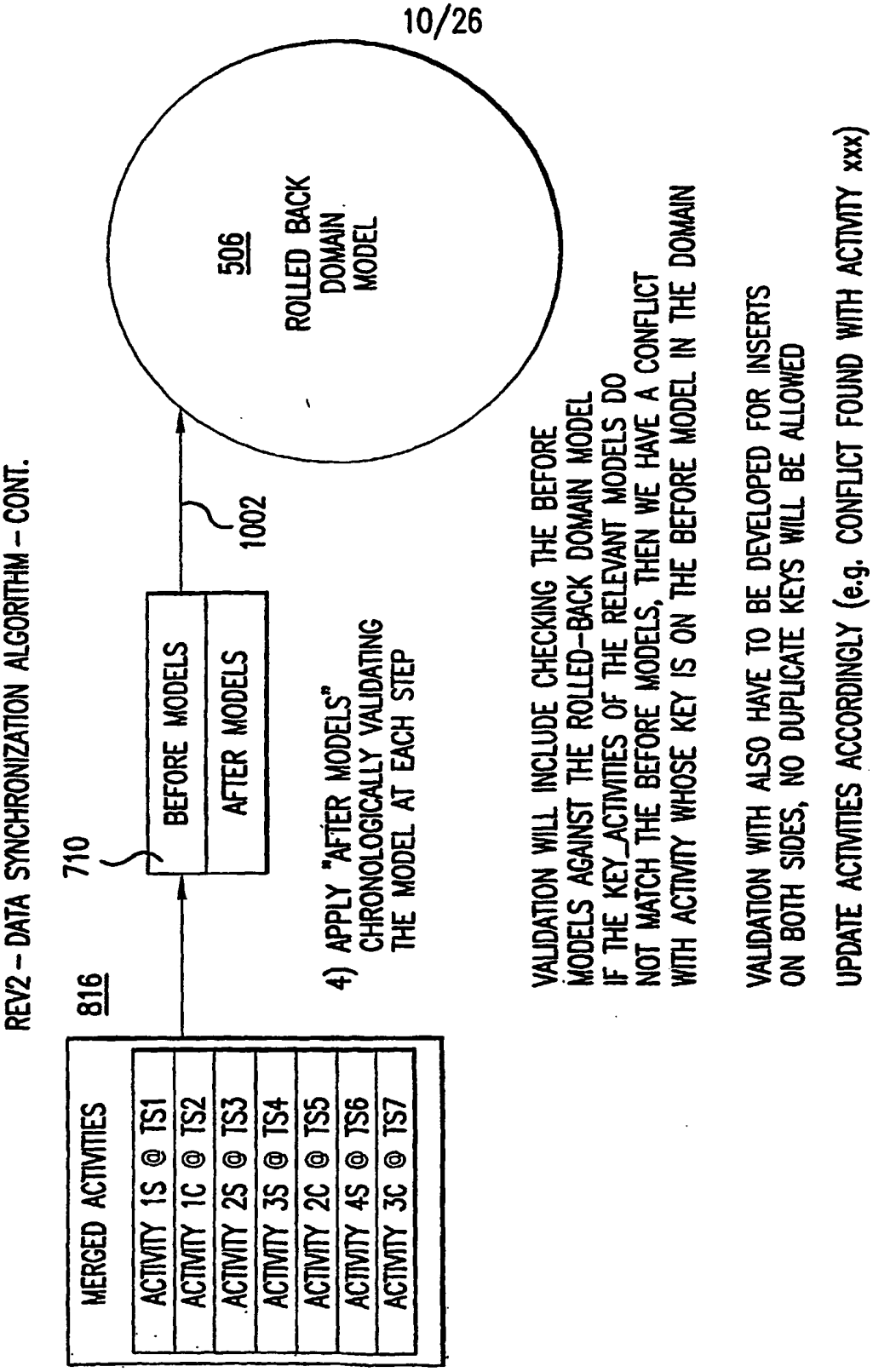
REV2 – DATA SYNCHRONIZATION ALGORITHM – CONT.
816
MERGED ACTIVITIES
ACTIVITY 1S @ TS1
ACTIVITY 1C @ TS2
ACTIVITY 2S @ TS3
ACTIVITY 3S @ TS4
ACTIVITY 2C @ TS5
ACTIVITY 4S @ TS6
ACTIVITY 3C @ TS7
710
BEFORE MODELS
AFTER MODELS
1002
506
ROLLED BACK DOMAIN MODEL
4) APPLY "AFTER MODELS" CHRONOLOGICALLY VALIDATING THE MODEL AT EACH STEP
VALIDATION WILL INCLUDE CHECKING THE BEFORE MODELS AGAINST THE ROLLED-BACK DOMAIN MODEL IF THE KEY_ACTIVITIES OF THE RELEVANT MODELS DO NOT MATCH THE BEFORE MODELS, THEN WE HAVE A CONFLICT WITH ACTIVITY WHOSE KEY IS ON THE BEFORE MODEL IN THE DOMAIN
VALIDATION WITH ALSO HAVE TO BE DEVELOPED FOR INSERTS ON BOTH SIDES, NO DUPLICATE KEYS WILL BE ALLOWED
UPDATE ACTIVITIES ACCORDINGLY (e.g. CONFLICT FOUND WITH ACTIVITY xxx)

FIG.10

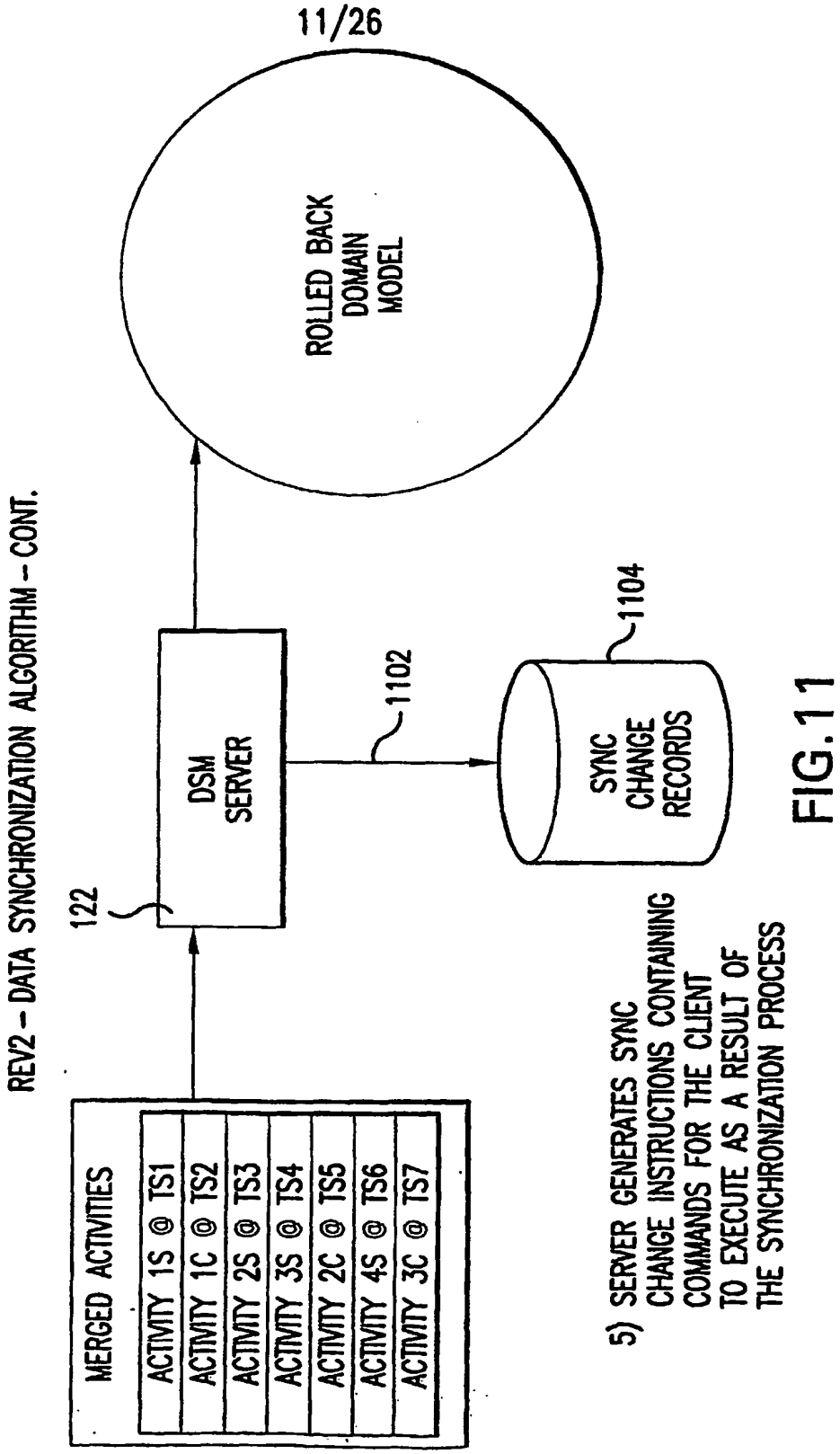
REV2 – DATA SYNCHRONIZATION ALGORITHM – CONT.
ROLLED BACK DOMAIN MODEL
DSM SERVER
122
1102
SYNC CHANGE RECORDS
1104
MERGED ACTIVITIES
ACTIVITY 1S @ TS1
ACTIVITY 1C @ TS2
ACTIVITY 2S @ TS3
ACTIVITY 3S @ TS4
ACTIVITY 2C @ TS5
ACTIVITY 4S @ TS6
ACTIVITY 3C @ TS7
5) SERVER GENERATES SYNC CHANGE INSTRUCTIONS CONTAINING COMMANDS FOR THE CLIENT TO EXECUTE AS A RESULT OF THE SYNCHRONIZATION PROCESS

FIG.11

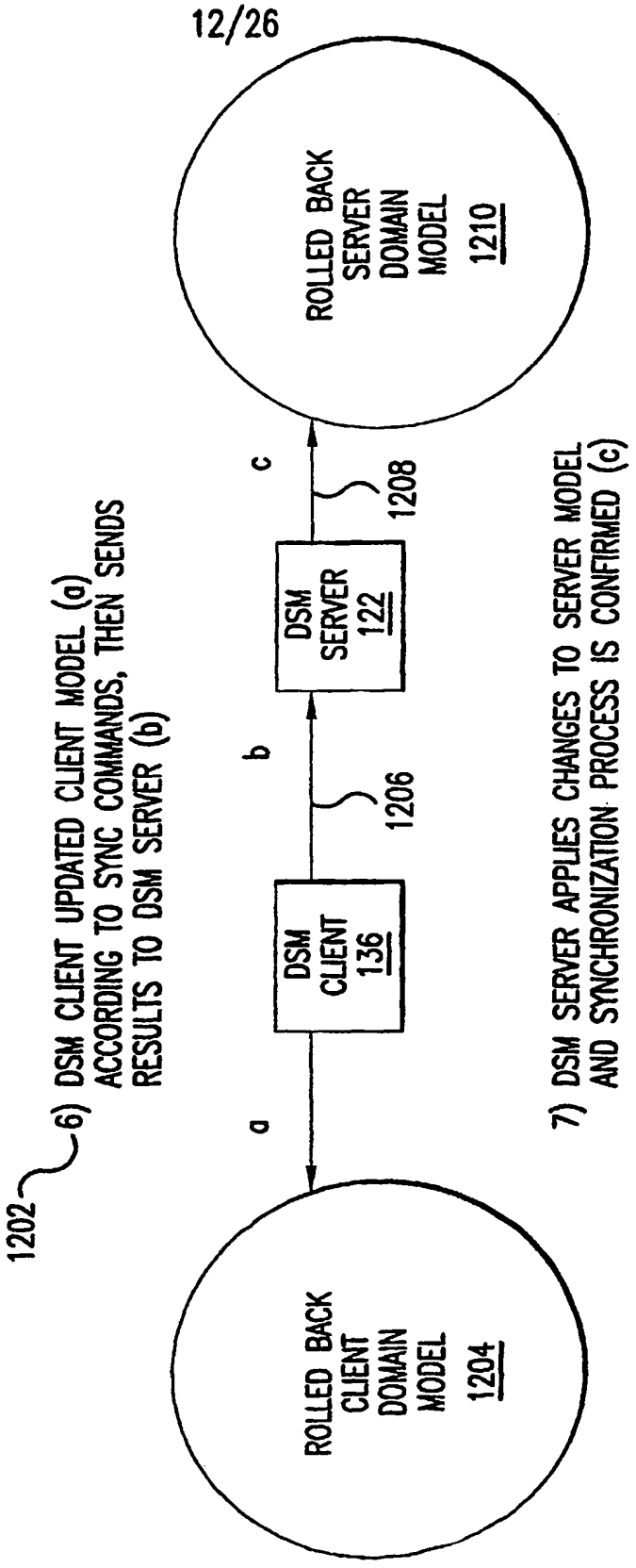
REV2 – DATA SYNCHRONIZATION ALGORITHM – CONT.
6) DSM CLIENT UPDATED CLIENT MODEL (a) ACCORDING TO SYNC COMMANDS, THEN SENDS RESULTS TO DSM SERVER (b)
1202
ROLLED BACK CLIENT DOMAIN MODEL 1204
DSM CLIENT 136
DSM SERVER 122
ROLLED BACK SERVER DOMAIN MODEL 1210
a
b
c
1206
1208
7) DSM SERVER APPLIES CHANGES TO SERVER MODEL AND SYNCHRONIZATION PROCESS IS CONFIRMED (c)

FIG.12

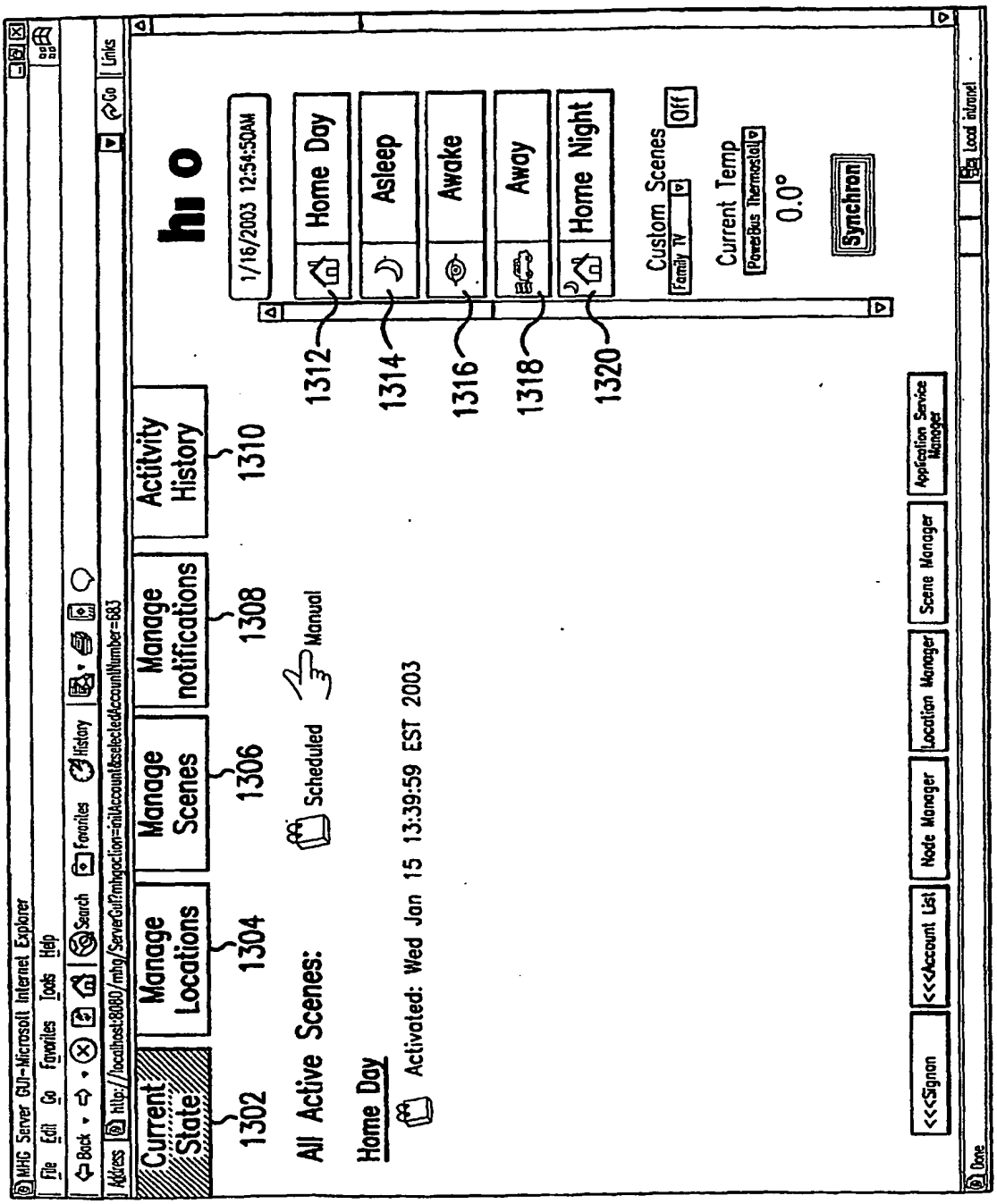
MHG Server GUI-Microsoft Internet Explorer
File Edit Go Favorites Tools Help
Back Search Favorites History
Address http://localhost:8080/mhg/ServerGui?mhgaction=initAccountSelectedAccountNumber=683
Links
Go
Current State
Manage Locations
Manage Scenes
Manage notifications
Activity History
1302
1304
1306
1308
1310
All Active Scenes:
Scheduled
Manual
Home Day
Activated: Wed Jan 15 13:39:59 EST 2003
1/16/2003 12:54:50AM
Home Day
Asleep
Awake
Away
Home Night
1312
1314
1316
1318
1320
Custom Scenes
Family TV
Off
Current Temp
PowerBus Thermostat
0.0°
Synchron
<<<Signon
<<<Account List
Node Manager
Location Manager
Scene Manager
Application Service Manager
Done
Local intranet

FIG. 13

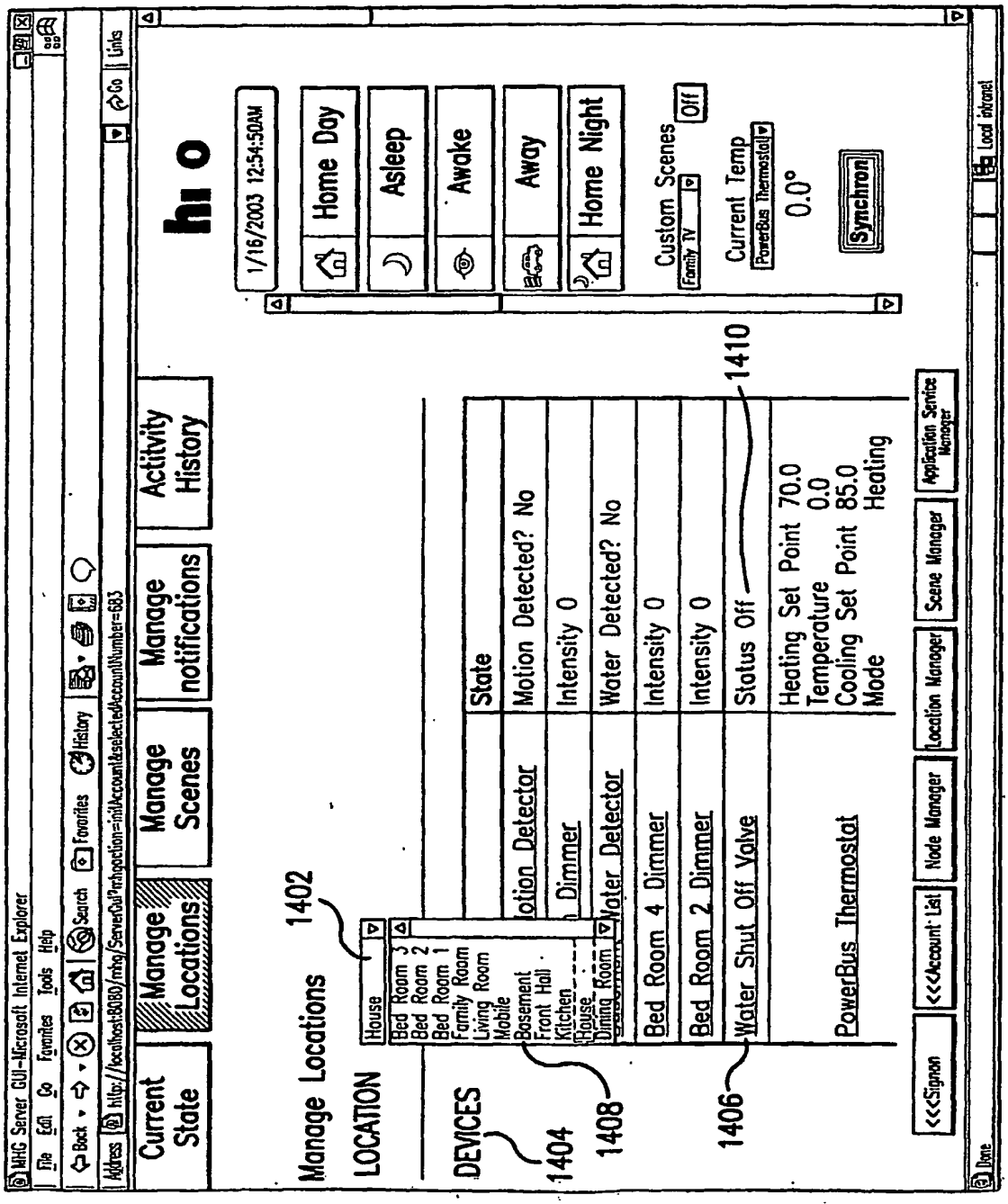
MHG Server GUI-Microsoft Internet Explorer
File Edit Go Favorites Tools Help
Back Search Favorites History
Address http://localhost:8080/mhg/ServerGui?action=initAccountAsSelectedAccountNumber=683
Links
Current State
Manage Locations
Manage Scenes
Manage notifications
Activity History
hi o
1/16/2003 12:54:50AM
Home Day
Asleep
Awake
Away
Home Night
Custom Scenes
Family TV
Off
Current Temp
PowerBus Thermostat
0.0°
Synchron
Manage Locations
1402
LOCATION
House
Bed Room 3
Bed Room 2
Bed Room 1
Family Room
Living Room
Mobile
Basement
Front Hall
Kitchen
House
Dining Room
DEVICES
1404
1408
1406
1410
State
otion Detector
Motion Detected? No
Dimmer
Intensity 0
Water Detector
Water Detected? No
Bed Room 4 Dimmer
Intensity 0
Bed Room 2 Dimmer
Intensity 0
Water Shut Off Valve
Status Off
PowerBus Thermostat
Heating Set Point 70.0
Temperature 0.0
Cooling Set Point 85.0
Mode Heating
<<<Signon
<<<Account List
Node Manager
Location Manager
Scene Manager
Application Service Manager
Done
Local intranet

FIG.14

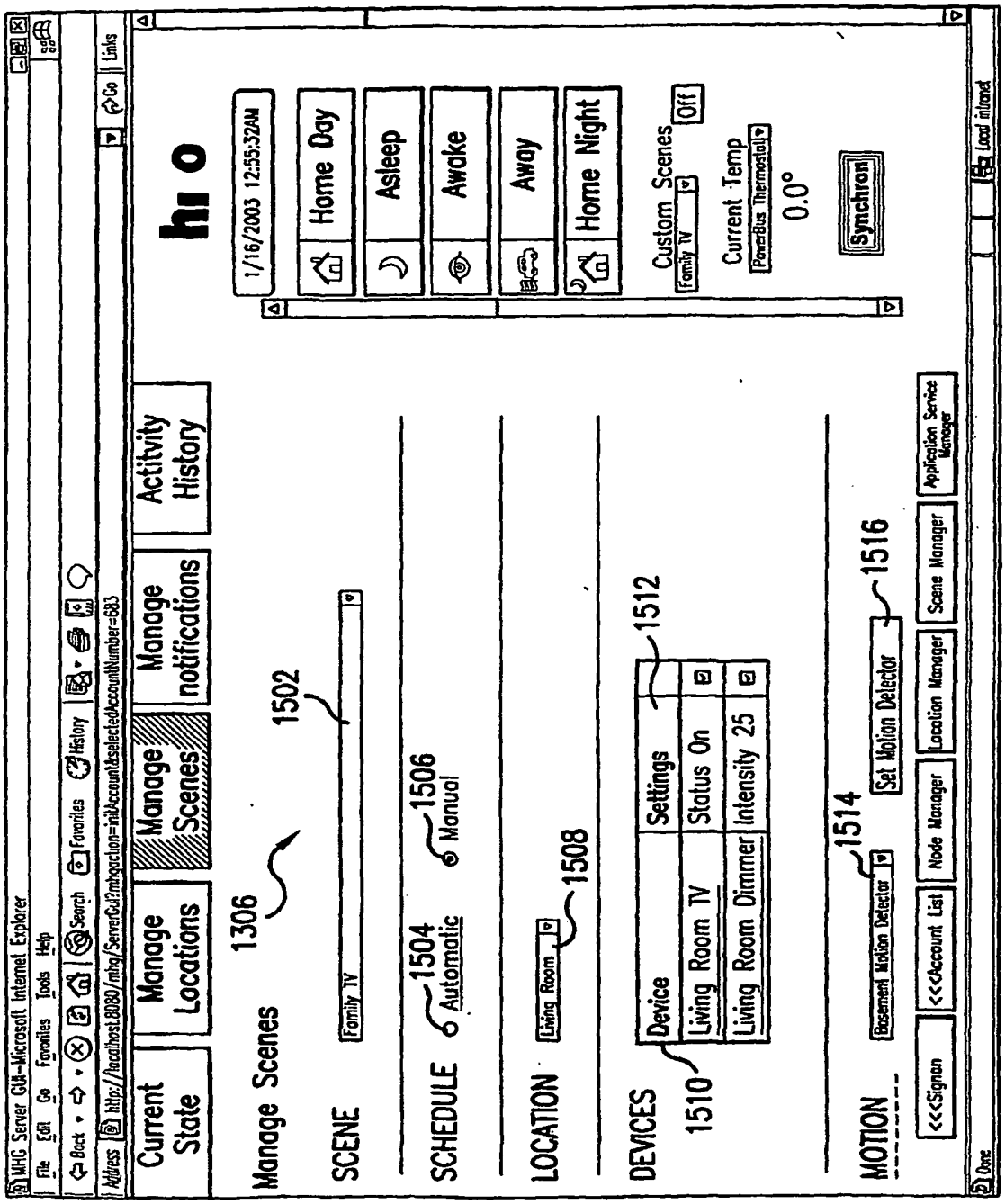
MHC Server GUI - Microsoft Internet Explorer
File Edit Go Favorites Tools Help
Back Search Favorites History
Address http://localhost:8080/mhq/ServerGui?mhqaction=initAccountAsselectedAccountNumber=683
Links
Current State
Manage Locations
Manage Scenes
Manage notifications
Activity History
hi o
1/16/2003 12:55:32AM
Home Day
Asleep
Awake
Away
Home Night
Custom Scenes
Family TV
Off
Current Temp
PowerBus Thermostat
0.0°
Synchron
Manage Scenes
1306
1502
SCENE
Family TV
SCHEDULE
1504
Automatic
1506
Manual
LOCATION
Living Room
1508
DEVICES
1510
Device
Settings
1512
Living Room TV
Status On
Living Room Dimmer
Intensity 25
MOTION
1514
Basement Motion Detector
Set Motion Detector
1516
<<Signain
<<Account List
Node Manager
Location Manager
Scene Manager
Application Service Manager
Done
Local intranet

FIG. 15

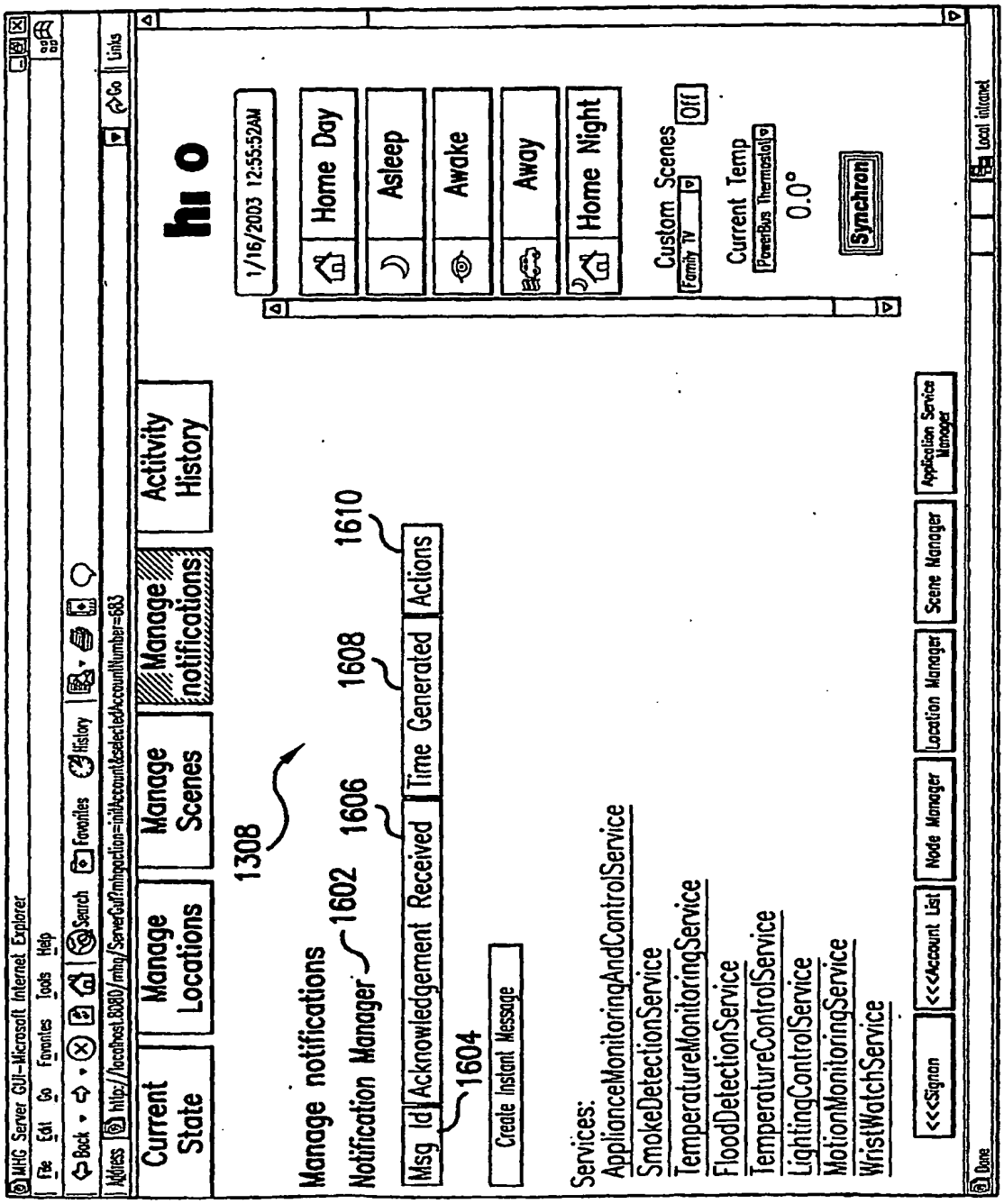
MHG Server GUI-Microsoft Internet Explorer
File Edit Go Favorites Tools Help
Back Search Favorites History
Address http://localhost:8080/mhg/ServerGui?mtgaction=initAccount&selectedAccountNumber=683
Links
Current State
Manage Locations
Manage Scenes
Manage notifications
Activity History
1308
Manage notifications
Notification Manager
1602
1606
1608
1610
Msg Id
Acknowledgement Received
Time Generated
Actions
1604
Create Instant Message
Services:
ApplianceMonitoringAndControlService
SmokeDetectionService
TemperatureMonitoringService
FloodDetectionService
TemperatureControlService
LightingControlService
MotionMonitoringService
WristWatchService
<<<Signon
<<<Account List
Node Manager
Location Manager
Scene Manager
Application Service Manager
Done
Local intranet
hi o
1/16/2003 12:55:52AM
Home Day
Asleep
Awake
Away
Home Night
Custom Scenes
Family TV
Off
Current Temp
PowerBus Thermostat
0.0°
Synchron

FIG. 16

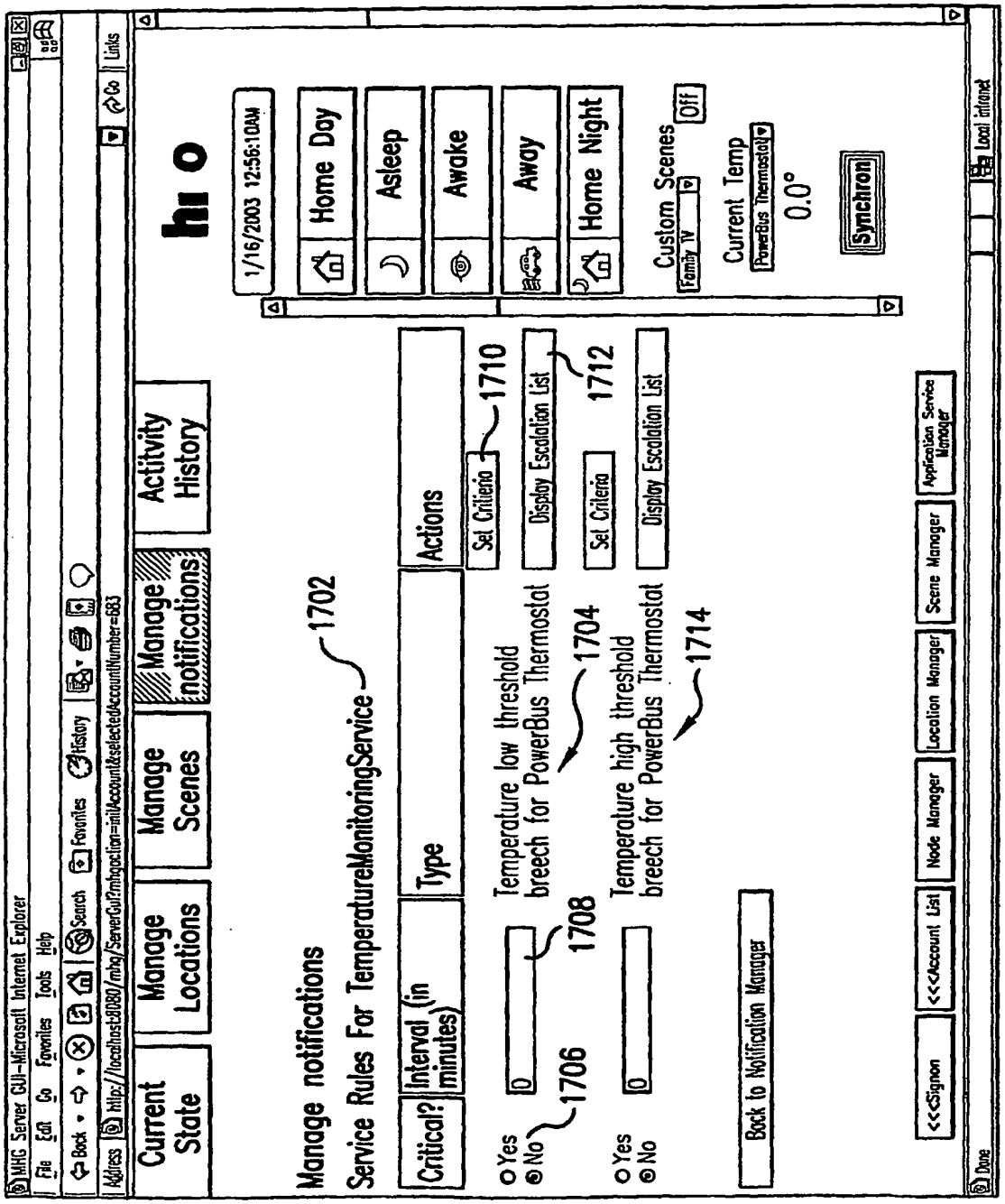
MHC Server GUI-Microsoft Internet Explorer
File Edit Go Favorites Tools Help
Back Search Favorites History
Address http://localhost:8080/mhc/ServerGui?mhcaction=initAccount&selectedAccountNumber=683
Links
Current State
Manage Locations
Manage Scenes
Manage notifications
Activity History
1/16/2003 12:56:10AM
Home Day
Asleep
Awake
Away
Home Night
Custom Scenes
Family TV
Off
Current Temp
PowerBus Thermostat
0.0°
Synchron
Manage notifications
Service Rules For TemperatureMonitoringService
1702
Critical?
Interval (in minutes)
Type
Actions
Set Criteria
1710
Display Escalation List
1712
Yes
No
1706
Temperature low threshold breech for PowerBus Thermostat
1704
1708
Temperature high threshold breech for PowerBus Thermostat
1714
Back to Notification Manager
<<<Signon
<<<Account List
Node Manager
Location Manager
Scene Manager
Application Service Manager
Done
Local intranet

FIG.17

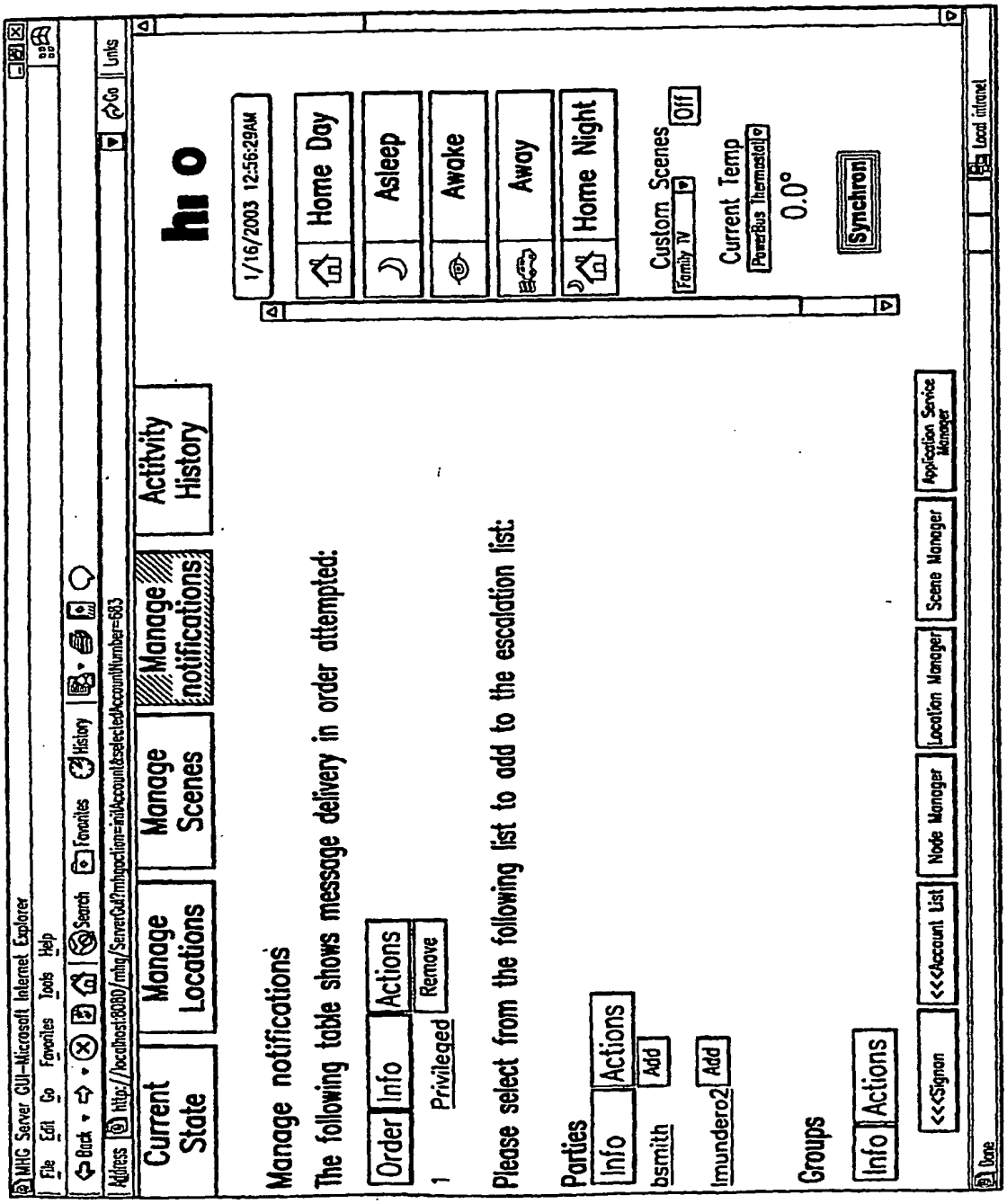
MHG Server GUI-Microsoft Internet Explorer
File Edit Go Favorites Tools Help
Back Search Favorites History
Address http://localhost:8080/mhg/ServerGui?mhgaction=initAccount&selectedAccountNumber=683
Links
Current State
Manage Locations
Manage Scenes
Manage notifications
Actitvity History
Manage notifications
The following table shows message delivery in order attempted:
Order Info Actions
1 Privileged Remove
Please select from the following list to add to the escalation list:
Parties
Info Actions
bsmith Add
lmundero2 Add
Groups
Info Actions
<<<Signon
<<<Account List
Node Manager
Location Manager
Scene Manager
Application Service Manager
Done
Local intranet
1/16/2003 12:56:29AM
Home Day
Asleep
Awake
Away
Home Night
Custom Scenes
Family TV
Off
Current Temp
PowerBus Thermostat
0.0°
Synchron

FIG.18

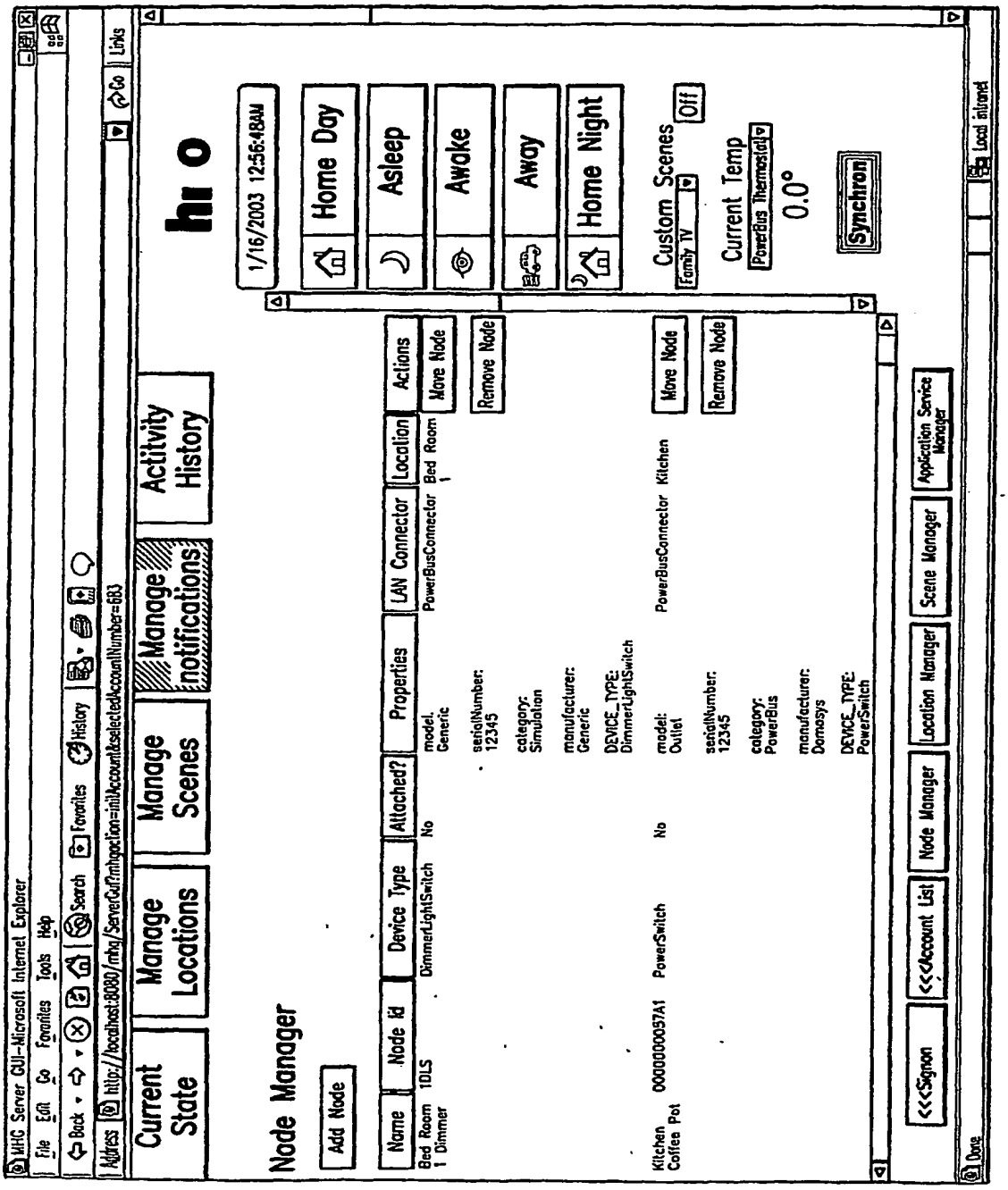
MHC Server GUI-Microsoft Internet Explorer
File Edit Go Favorites Tools Help
Back Search Favorites History
Address http://localhost:8080/mhg/ServerGui?mhgaction=initAccount&selectedAccountNumber=683
Links
Current State
Manage Locations
Manage Scenes
Manage notifications
Activity History
hi o
1/16/2003 12:56:48AM
Home Day
Asleep
Awake
Away
Home Night
Custom Scenes
Family TV
Off
Current Temp
PowerBus Thermostat
0.0°
Synchron
Node Manager
Add Node
Name
Node Id
Device Type
Attached?
Properties
LAN Connector
Location
Actions
Bed Room 1 Dimmer
1DLS
DimmerLightSwitch
No
model: Generic
serialNumber: 12345
category: Simulation
manufacturer: Generic
DEVICE_TYPE: DimmerLightSwitch
PowerBusConnector
Bed Room 1
Move Node
Remove Node
Kitchen Coffee Pot
0000000037A1
PowerSwitch
No
model: Outlet
serialNumber: 12345
category: PowerBus
manufacturer: Domosys
DEVICE_TYPE: PowerSwitch
PowerBusConnector
Kitchen
Move Node
Remove Node
<<<Signon
<<<Account List
Node Manager
Location Manager
Scene Manager
Application Service Manager
Done
Local intranet

FIG.19

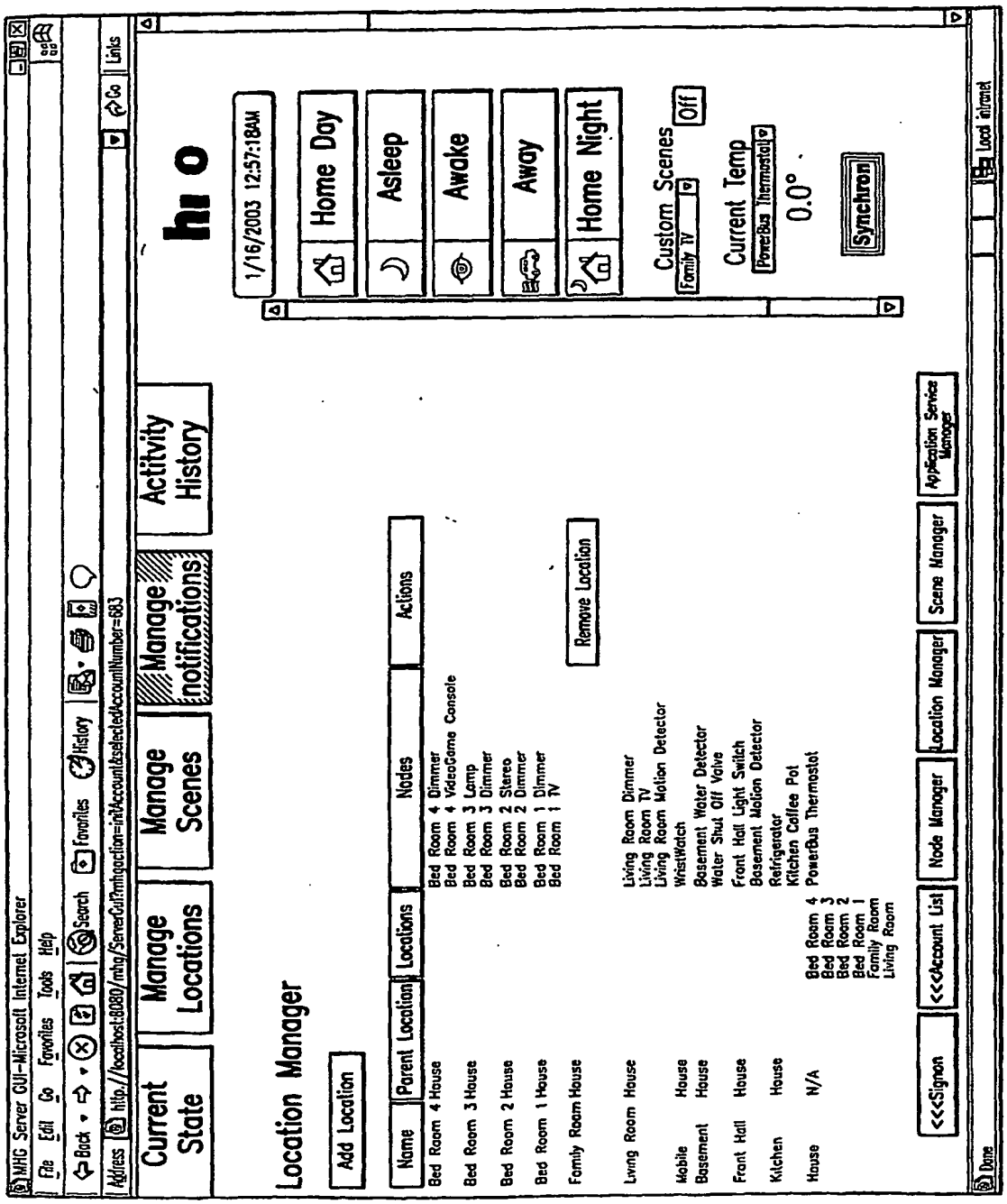
MHG Server GUI-Microsoft Internet Explorer
File Edit Go Favorites Tools Help
Back Search Favorites History
Address http://localhost:8080/mhg/ServerGui?mhgaction=initAccount&selectedAccountNumber=683
Links
Current State
Manage Locations
Manage Scenes
Manage notifications
Activity History
Location Manager
Add Location
Name
Parent Location
Locations
Nodes
Actions
Bed Room 4 House
Bed Room 4 Dimmer
Bed Room 4 VideoCame Console
Bed Room 3 House
Bed Room 3 Lamp
Bed Room 3 Dimmer
Bed Room 2 House
Bed Room 2 Stereo
Bed Room 2 Dimmer
Bed Room 1 House
Bed Room 1 Dimmer
Bed Room 1 TV
Family Room House
Remove Location
Living Room House
Living Room Dimmer
Living Room TV
Living Room Motion Detector
Mobile House
WristWatch
Basement House
Basement Water Detector
Water Shut Off Valve
Front Hall House
Front Hall Light Switch
Basement Motion Detector
Kitchen House
Refrigerator
Kitchen Coffee Pot
House N/A
Bed Room 4 PowerBus Thermostat
Bed Room 3
Bed Room 2
Bed Room 1
Family Room
Living Room
<<<Signon
<<<Account List
Node Manager
Location Manager
Scene Manager
Application Service Manager
Done
Local intranet
1/16/2003 12:57:18AM
Home Day
Asleep
Awake
Away
Home Night
Custom Scenes
Family TV
Off
Current Temp
PowerBus Thermostat
0.0°
Synchron

FIG.20

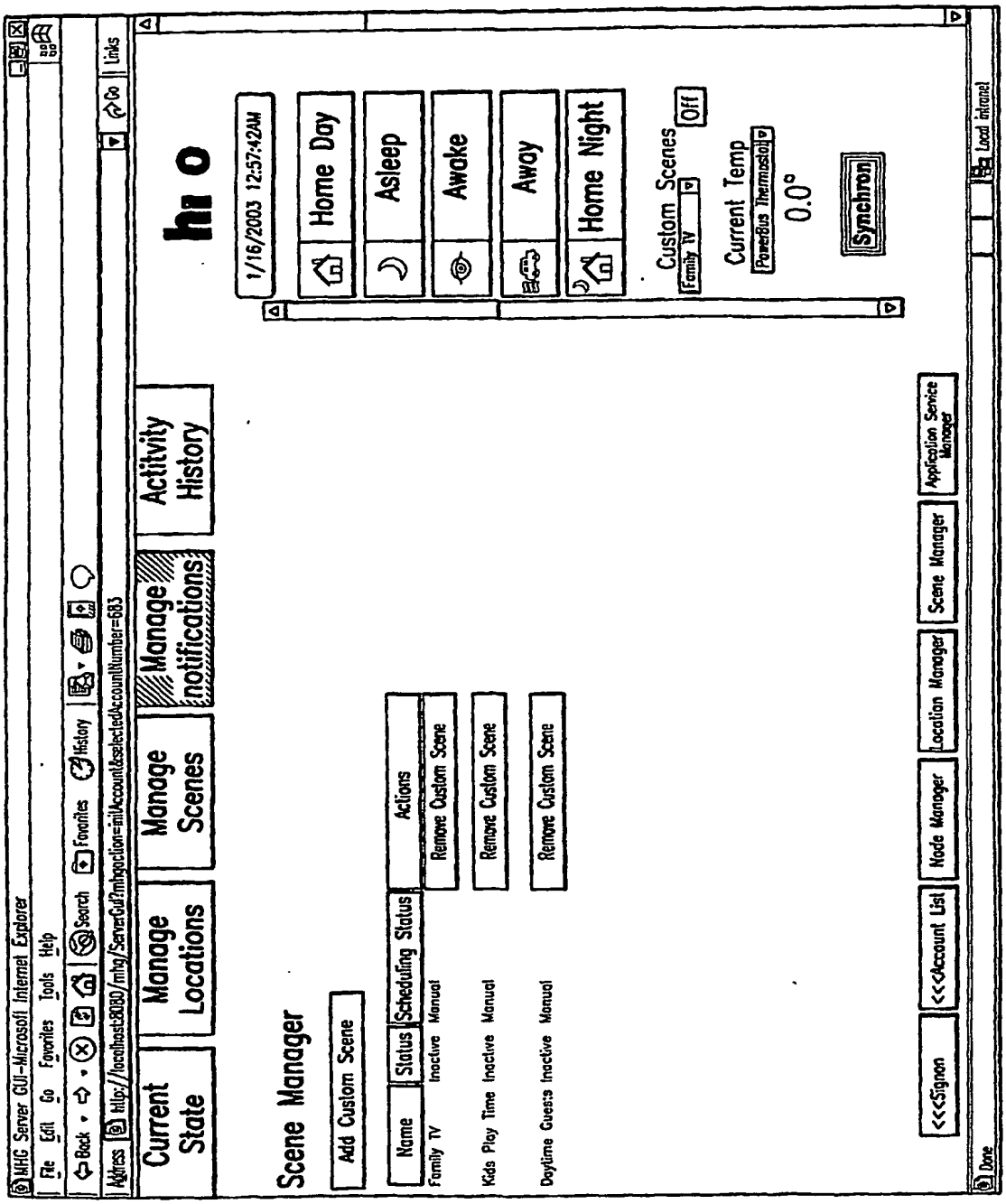
MHC Server GUI-Microsoft Internet Explorer
File Edit Go Favorites Tools Help
Back Search Favorites History
Address http://localhost:8080/mhg/ServerGui?mhgaction=initAccount&selectedAccountNumber=683
Links
Current State
Manage Locations
Manage Scenes
Manage notifications
Activity History
Scene Manager
Add Custom Scene
Name
Status
Scheduling
Actions
Family TV Inactive Manual
Remove Custom Scene
Kids Play Time Inactive Manual
Remove Custom Scene
Daytime Guess Inactive Manual
Remove Custom Scene
hi o
1/16/2003 12:57:42AM
Home Day
Asleep
Awake
Away
Home Night
Custom Scenes
Family TV
Off
Current Temp
PowerBus Thermostat
0.0°
Synchron
<<<Signon
<<<Account List
Node Manager
Location Manager
Scene Manager
Application Service Manager
Done
Local intranet

FIG.21

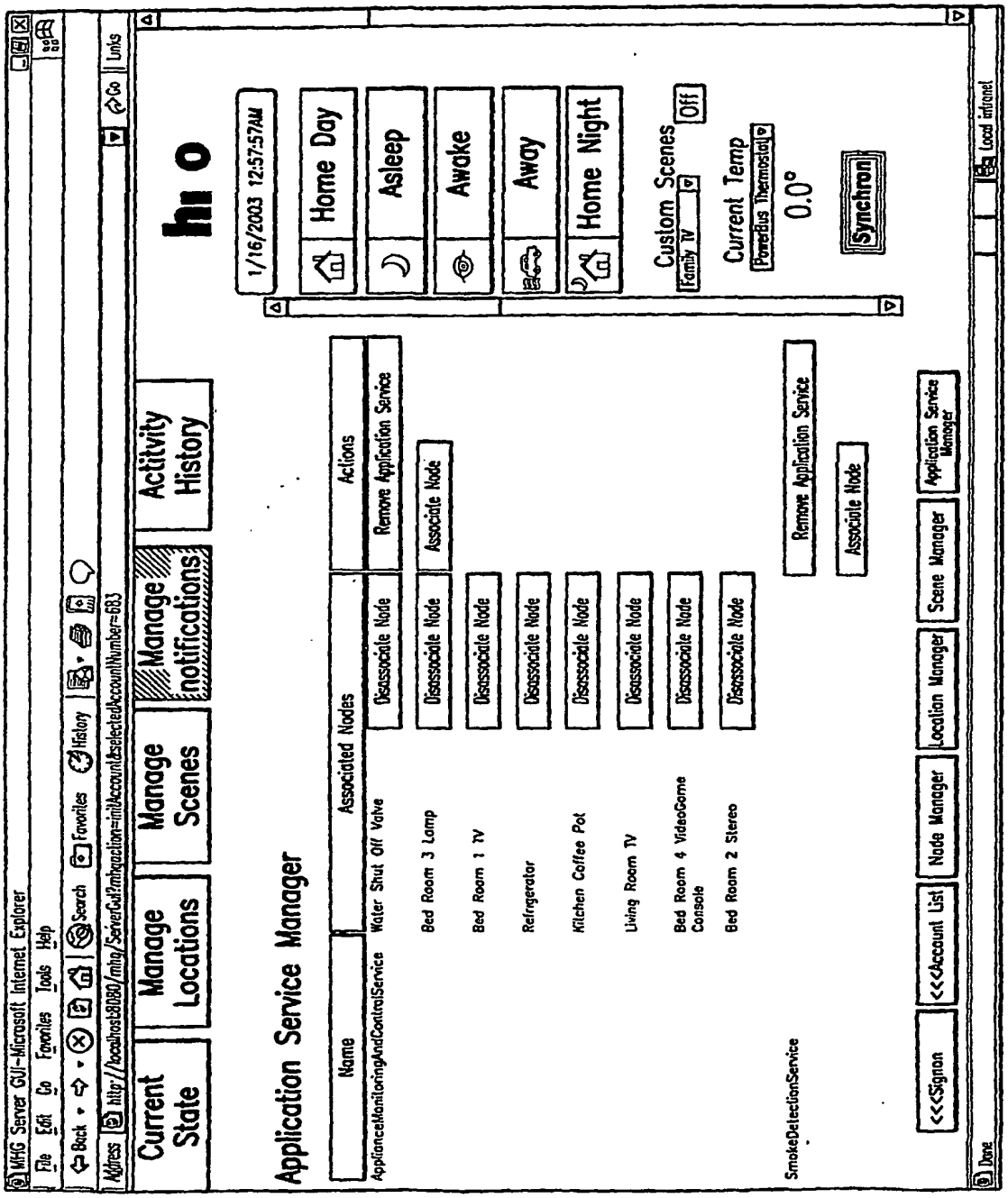
MHG Server GUI-Microsoft Internet Explorer
File Edit Go Favorites Tools Help
Back Search Favorites History
Address http://localhost:8080/mhg/ServerGui?mkaction=initAccount&selectedAccountNumber=683
Links
Current State
Manage Locations
Manage Scenes
Manage notifications
Activity History
Application Service Manager
Name
Associated Nodes
Actions
ApplianceMonitoringAndControlService
Water Shut Off Valve
Disassociate Node
Remove Application Service
Bed Room 3 Lamp
Disassociate Node
Associate Node
Bed Room 1 TV
Disassociate Node
Refrigerator
Disassociate Node
Kitchen Coffee Pot
Disassociate Node
Living Room TV
Disassociate Node
Bed Room 4 VideoGame Console
Disassociate Node
Bed Room 2 Stereo
Disassociate Node
SmokeDetectionService
Remove Application Service
Associate Node
<<<Signon
<<<Account List
Node Manager
Location Manager
Scene Manager
Application Service Manager
Done
Local intranet
1/16/2003 12:57:57AM
Home Day
Asleep
Awake
Away
Home Night
Custom Scenes
Family TV
Off
Current Temp
Powerflex Thermostat
0.0°
Synchron

FIG.22

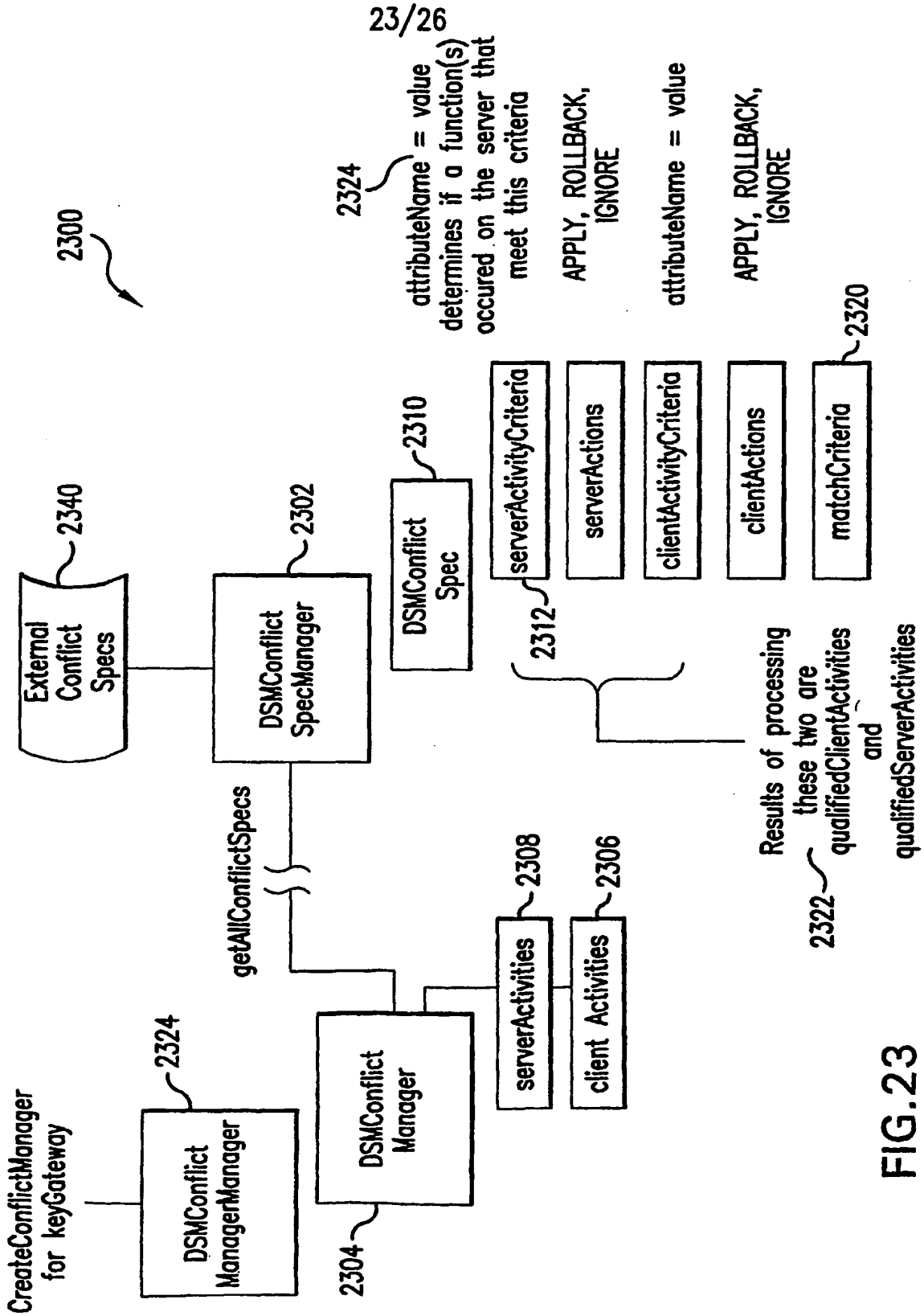
2300
2324
attributeName = value determines if a function(s) occured on the server that meet this criteria
APPLY, ROLLBACK, IGNORE
attributeName = value
APPLY, ROLLBACK, IGNORE
2340
External Conflict Specs
2302
DSMConflict SpecManager
2310
DSMConflict Spec
serverActivityCriteria
serverActions
clientActivityCriteria
clientActions
matchCriteria
2320
2312
getAllConflictSpecs
2308
serverActivities
2306
client Activities
Results of processing these two are qualifiedClientActivities and qualifiedServerActivities
2322
CreateConflictManager for keyGateway
2324
DSMConflict ManagerManager
DSMConflict Manager
2304

FIG.23

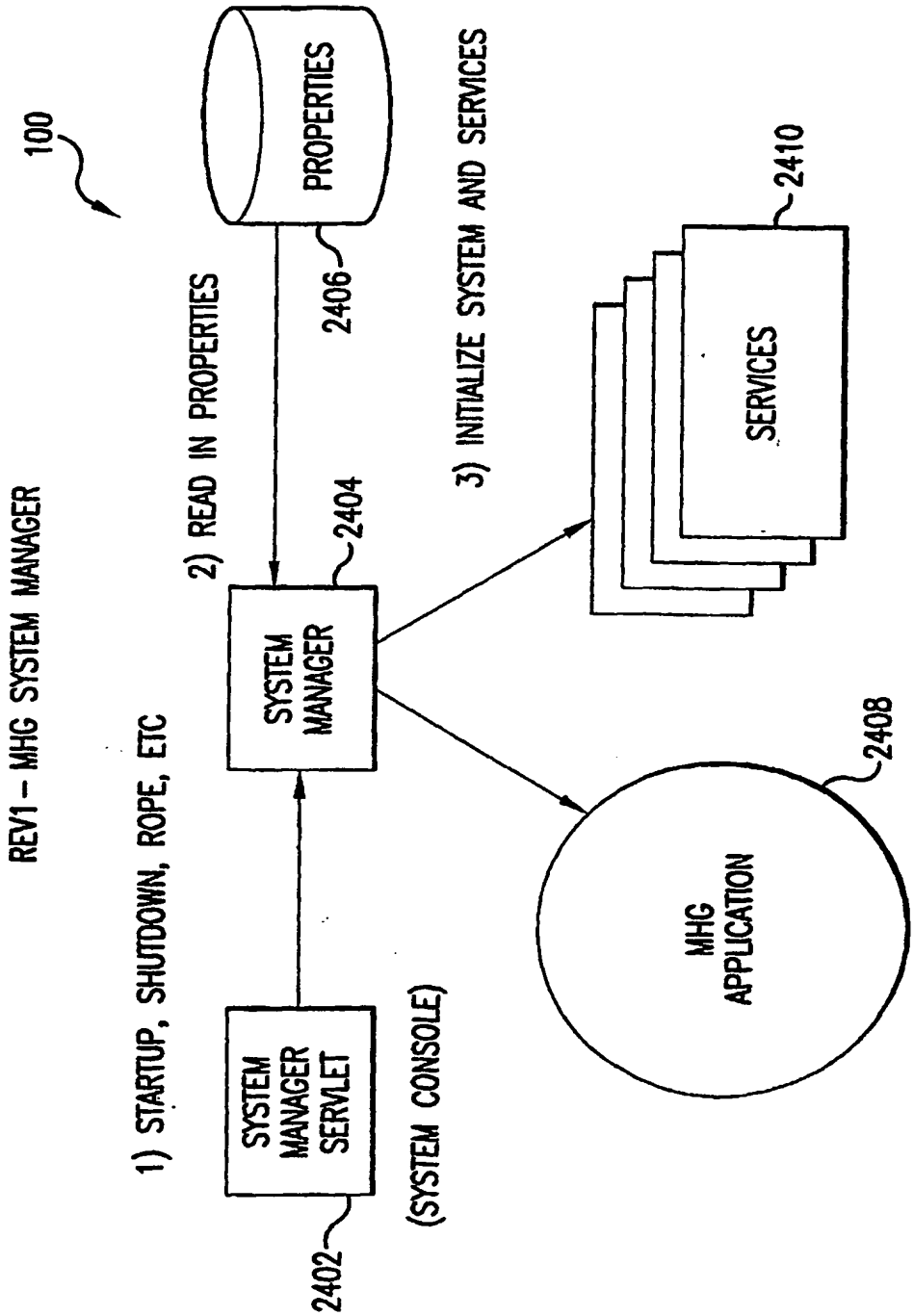
100
REV1 – MHG SYSTEM MANAGER
PROPERTIES
2406
2) READ IN PROPERTIES
3) INITIALIZE SYSTEM AND SERVICES
2410
SERVICES
2404
SYSTEM MANAGER
2408
MHG APPLICATION
1) STARTUP, SHUTDOWN, ROPE, ETC
(SYSTEM CONSOLE)
SYSTEM MANAGER SERVLET
2402

FIG.24

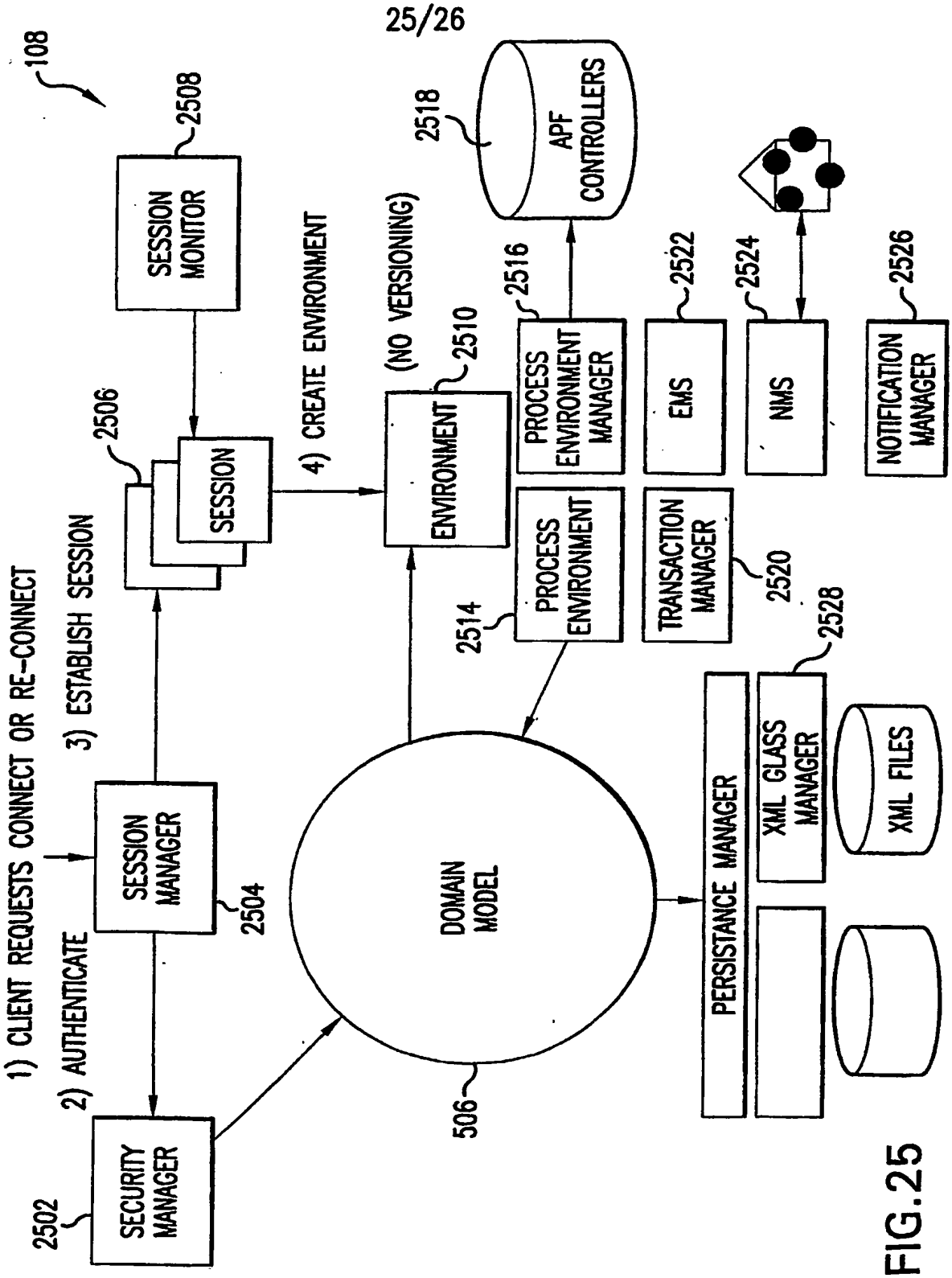
108
2508
SESSION MONITOR
2506
SESSION
1) CLIENT REQUESTS CONNECT OR RE-CONNECT
2) AUTHENTICATE
3) ESTABLISH SESSION
4) CREATE ENVIRONMENT
(NO VERSIONING)
2510
ENVIRONMENT
2518
APF CONTROLLERS
2516
PROCESS ENVIRONMENT MANAGER
2522
EMS
2524
NMS
2526
NOTIFICATION MANAGER
2514
PROCESS ENVIRONMENT
TRANSACTION MANAGER
2520
2528
SESSION MANAGER
2504
DOMAIN MODEL
PERSISTANCE MANAGER
XML GLASS MANAGER
XML FILES
2502
SECURITY MANAGER
506

FIG.25

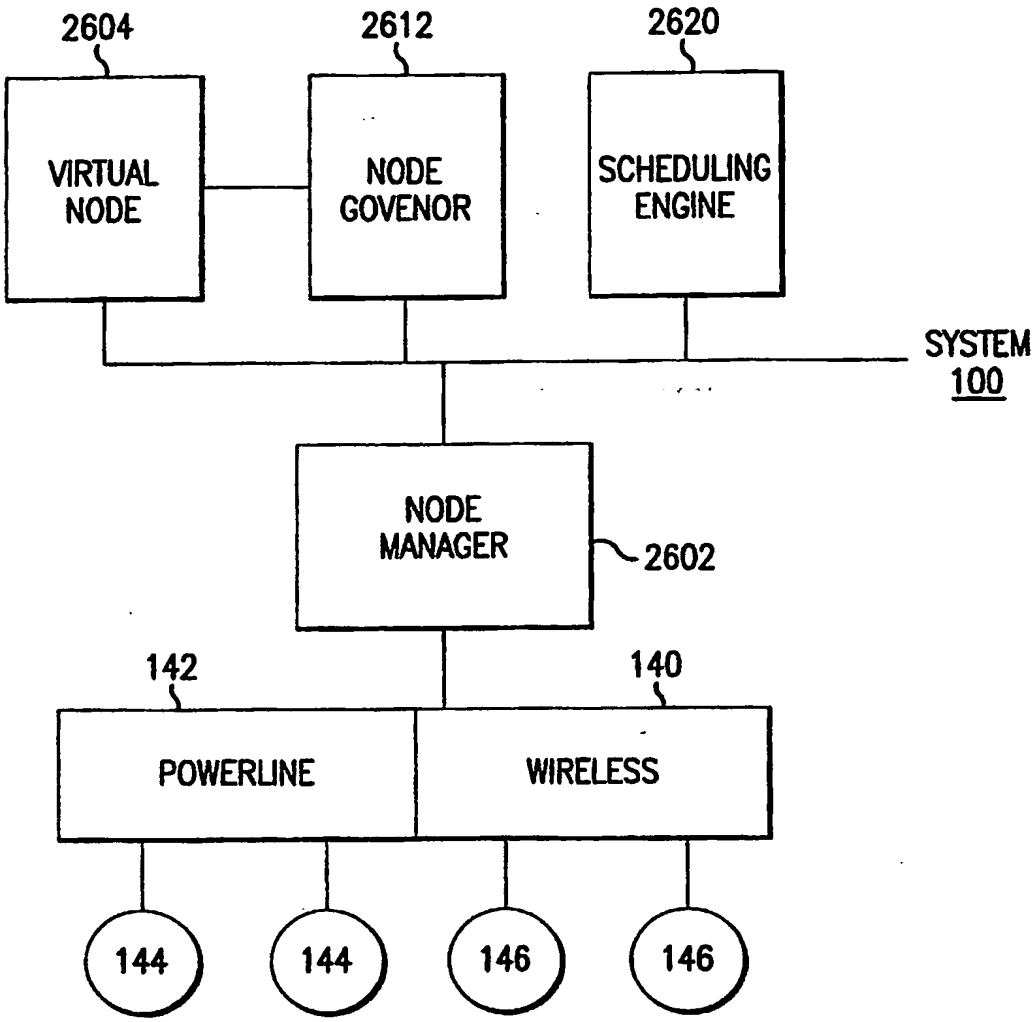
2604
2612
2620
VIRTUAL NODE
NODE GOVENOR
SCHEDULING ENGINE
SYSTEM 100
NODE MANAGER
2602
142
140
POWERLINE
WIRELESS
144
144
146
146

FIG.26